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ENTERED AT THE POST OFFICE AT NEW YORK, N. Y., AS SECOND-CLASS MATTER.

BRIEFLY TOLD.

"REPORT OF COMMITTEE ON A UNIFORM SYSTEM OF ACCOUNTS FOR GAS COMPANIES, PRESENTED BY THE COMMITTEE THEREON APPOINTED AT THE LAST MEETING OF THE AMERICAN GAS LIGHT ASSOCIATION.—What follows may only be a new proof of the saying, 'Cobbler, stick to your last,' and what might be expected when a street man presumes to pass judgment on office and bookkeeping matters. Be this as it may, the temptation to say something about the 'Black Book' that lies before me is not to be resisted. The value of the work is exceptionally high, viewed either at the price the Committee would have charged for the time they have spent; or, still more so, viewed in the light of results accomplished. With this book in hand, any man who understands bookkeeping is able to have a perfect set of gas accounts, even though he may never have heard of a gas works before, is able to know exactly the money invested in his plant, what his gas costs, and to see at just what points expenses are too high and are possible of reduction. Only those who have assisted in the development of a system of gas accounts are able to fully appreciate how much work lies back of this book, and how it enables any who will follow it to profit by the best thought in their profession. The binding of the book is suited for its use as a desk companion, and its contents are so well arranged and indexed that all the information between the covers is instantly available. Throughout, the aim has been to spare no words where their use would conduce to clearness of understanding. No one can fail to admire the lucid definition of each account and the completeness of the list of items shown. How valuable the series of closing entries will prove to many superintendents who have responsible oversight of the bookkeeping. Coming to the accounts themselves, the refinement of those devoted to residuals will appeal to any man (and their number is not a few, even to-day), who has credited tar, coke and ammonia with the money each brought in, but lumped the expenses of handling all these residuals into one account, with the result that the net return from each residual was never known. Another valuable account under manufacture is 'Coke Special,' enabling proper credit to be given coal gas and proper comparison made with water gas costs. Distribution work is given eight accounts which cover the field in sufficient detail for most companies, and are so arranged that where more accounts are desired these latter may be closed into the accounts given for comparison with other companies. Thus, where turning on and off gas is made a special account, it would be closed into 'Setting and Removing Meters,' and the latter would be in shape to compare correctly with companies that did not specialize. The abolition of 'Distribution Labor' and 'Distribution Expense,' those two dumping grounds for so many expenses, the classification of which seemed difficult, is a great gain. The accounts as they now stand enable job costs to be obtained, and, therefore, a proper watch kept of distribution economy. The commercial and general accounts are in line with all the others in securing a proper classification of expenses. Those companies who have never cared for advance or accrued payment of taxes, insurance, etc., and who remain unconverted after reading this book, certainly belong to those who 'won't see.' The two sets of accounts 'Store Room' and 'Expense Store Room,' 'Stable' and 'Expense Stable,' show respectively the only satisfactory ways of arriving at correct charges for all material, and the cost of

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company hauling. Here, again, light is available for those who are willing to use it. The stock accounts as outlined make certain that all variation in monthly results should be looked for in the apparatus and workmen, and may not be attributed to vagaries of bookkeeping. Those who work on a large scale, and for estimate purposes need costs based on extensive data, will appreciate the accounts for keeping street main costs by sizes. It is advisable, from the office standpoint, especially in small companies, to know the cost of each extension laid for new business, in order that profits from an extension may be figured in percentage of total cost; but there are some companies who know what each extension has cost, but because they don't lump all the extensions of the same size together, and then arrive at an average cost per foot of that size, are not in as good a position to make a very exact estimate of the cost of any extension as they would be if they used the Committee's system. The dovetailing of the Junior into the Senior System of accounts enables the workings of large companies to be properly compared to those of small ones. For the benefit of any of the latter who still keep their books according to some prehistoric system, the writer offers the opinion that the adoption of the 'Junior' system (assuming they are too small for the 'Senior') will enhance their properties, as the buyer is apt to *take* the benefit of any doubt, and there are many such doubts when trying to arrive at true earnings from an archaic set of books. Surely, the man who has a paying property should see that his accounts declare the fact. It remains to be seen how universal will be the adherence to the Committee's work; but, whether or not the light now given is used, the Committee have the satisfaction of knowing they have performed a great service for their profession.—W. F."

NOTES——

WE regret to be called upon to chronicle the death of Mrs. H. C. Bush, the estimable wife of Captain W. H. White's efficient and faithful Secretary. Her demise, which was the sad sequel to a long illness, occurred the afternoon of the 4th inst.

THE Directors of the Granville (N. Y.) Electric and Gas Company have perfected the following organization: President, F. T. Pember, Granville; Vice-President, B. G. Higby, Sandy Hill; Secretary and Treasurer, E. R. Norton, Granville.

THE Mayor of Leavenworth, Kas., has vetoed the franchise for an opposition gas plant in that city, recently granted by the Council to Wm. Docking, L. Kreck and others.

IT is estimated that the gain on new meters set by the Peoples Gas Light and Coke Company during the current year will be not far from 30,000. Last year (1902) the gain was 11,000. The banner meter gain year in the history of the Company was 1899, when 44,401 meters were placed.

WE are indebted to Mr. A. E. Lester, Secretary of the Scranton (Pa.) Engineers' Club, for a copy of its well gotten up Directory for the current year.

The Paris Subway Horror.

Engineering News notes that the inquiry into the Paris subway accident of August 10, is being conducted with much secrecy, according to our European contemporaries. Some few facts have, however, leaked out and such of these as are of general interest are given. The Prefect of Police has ordered the Company to carry out the following improvements: In each station and in the tunnel are to be placed lamps connected with the city mains and independent of the Metropolitan railway current. Fire plugs are to be placed in each station and so arranged that the turning on of the water will automatically cut off the current. Fire alarms are to be placed in the tunnel at intervals and each station is to be connected by telephone with the nearest fire station. A staircase is to be built at each end of the station platforms. M. André Berthelot, Managing Director of the Metropolitan Company, states that the Company is considering various devices for isolating the electrical mechanism from the vehicles. It is also intended to construct the rolling stock with fireproof material. The most important feature of the inquiry, however, is that relating to the electrical equipment of the line. It is generally recognized that the live rail on the track is a danger in the event of passengers being required to get out of a disabled train in the tunnel; it is therefore proposed to place it overhead; but further evidence has been received which points to the possibility of the electrical equipment being changed altogether, as the Commission appears to have been greatly impressed by the explanations which were given concerning the magnetic system of traction which has been experimented with for several months past at the works of Dutuit, of Charleroi. In this system electro magnets are placed at certain distances between the rails, and the coach is drawn from one to the other, each being demagnetized as the coach passes over it. The system is said to have given such excellent results that it is regarded in Belgium with considerable favor, and the Paris authorities intend fully to investigate it, with a view of seeing whether it can be satisfactorily employed on the Metropolitan.

[Continued from Page 363.]

ELEVENTH ANNUAL MEETING, PACIFIC COAST GAS ASSOCIATION.

HELD IN SAN FRANCISCO, CAL., JULY 21-23, 1903.

FIRST DAY—MORNING SESSION.

The President—It is now within 25 minutes of our lunch hour. Although we have a little time on our hands, I do not think it would be advisable to start reading the papers and have them interrupted during the lunch hour. Are there any other matters of interest that should come up?

The Secretary—I would like to say a few words regarding the "Question Box." Probably all of you are familiar with the work done by the Ohio Gas Light Association. They went into it, under the direction of Mr. Henry L. Doherty as Editor, in an elaborate way. He sent notices to the members of the several Gas Associations in the United States whose addresses he could find, asking that questions be sent to him—questions of importance to the individual to whom the notices were sent. In response he received an overwhelming number of questions. He then undertook the task not of exactly assigning the questions, but rather arranging them under various heads, such as manufacture, distribution, etc. Printed copies were sent to various gas men throughout the United States requesting them to answer as many questions as they could. After a number of months of hard work Mr. Doherty published a book (we have a copy of it in the library) giving these questions, the answers thereto and the names of the gas men throughout the country contributing such. I do not think anyone really appreciates the amount of work expended on this sort of thing, and I hardly think we realize the value it is to our Associations and to gas men in general. I think that for a long time to come we shall feel the benefit of this publication. It occurred to me that we might do something of the same sort in our Association, but not on quite such an elaborate plan. We might confine ourselves to the Pacific Coast district. We might also depart from Mr. Doherty's plan in this respect. He received answers from various good sources, but many of them practically unknown. I find in looking over his publication a number of conflicting answers. A great many questions received answers in the affirmative and in the negative. Others went into more detail and gave the reasons for the answers. In looking over the book I have found myself several times in this dilemma: A question was asked. One man answered it "Yes;" another man answered it in the same terse way, "No." I find I am no nearer the solution of the difficulty. It occurred to me that we might send out requests to the members of our Association to ask questions of the *Association*—not to be sent out for answer to any individual member of the Association, but to be answered *by the Association*. By that I mean that the Association would, in so far as it is possible, be responsible; that there would be a certain moral responsibility for the answering of these questions. A man wants to know something. He has no facilities for looking the matter up, and sends the question to the Pacific Coast Gas Association (not to any individual member whom the Secretary may see fit to select), and the Association, through its officers, endeavors to get a correct answer for that question. Of course, I realize that it is not always possible to do this. But we can, in a great measure, get good and reliable answers to the questions if the officers of the Association will take sufficient interest in it and devote enough of their time to the matter to reply in proper form to the questions. That means that somebody will have to do a good deal of work, as the best-informed man must refer to authorities; but it occurred to me that where a question is sent in, someone who has the interests of the Association at heart could make it his business to look the matter up and make something in the nature of a short report which could be read at the succeeding meeting of the Association. I believe that if the proper interest is shown in the "Question Box" it may be made one of the most valuable features of our Association on these lines. I took it up this year and sent out postals asking the members to send in questions of great interest to them personally, and saying that the Association would answer them. The time was short, and I cannot say that I have met with the success which I had hoped for. We received, I think, in the neighborhood of 15 questions. For some of these I have good, reliable answers; for some I have not succeeded in getting any answers at all. I have noticed also that these questions could be divided into two classes: One which could be answered with absolute certainty, to which you could give just the information wanted by the questioner. For instance, one man writes to know how many feet of gas he will have as ordinarily measured if he compresses it in a cylinder of a given size to a certain pressure; say, 15, 20, 40, 60 or 100 pounds. He knows that he has more

gas in that cylinder than he would have in a gasholder of the same size under the ordinary gas pressure of 3 or 4 inches; but he does not know just how much. This is a question to which a definite answer can be given. It is simply a matter of someone's putting the matter in such form that it will be clear to the questioner. This question came from a man in one of the smaller towns a long way from the great centers. He had absolutely no way of getting the information, and he appealed to the Association. I think that is the proper function of our Association; and I find that quite a number of the questions are of a similar sort, inasmuch as they will admit of a definite answer. On the other hand, a good many of them are such questions as this: "Is it good policy to set two gas meters; one for fuel and one for light?" Now, that is largely a matter of individual opinion. In questions of this sort we cannot undertake to give information which will be absolutely reliable. At the same time even a question of that nature can be answered to the best ability of the officers of the Association. It can be propounded at the meeting, too, and will result in discussion which should bring out a good deal of valuable information.

Mr. Lowe—What suggestions have you as to the best way of reaching these men and getting this "Question Box" in motion? Is your idea that it should be made a permanent affair? Are you going to do it through individual work, through a committee, or how? We already have an Advisory Board which is supposed to act somewhat in that way.

The Secretary—I think it comes within the province of the Advisory Board, and should be attended to possibly by the Secretary, subject to their direction. That is a matter of detail which can be easily attended to and does not require action on the part of the Association. But I do think the matter should be brought to the attention of the Association at its meeting, and that an effort should be made to impress the members with the value of it. I think it can be made a valuable feature of our Association.

Mr. Lowe—I quite agree with you.

The Secretary—I will now take up the first question to which I have an answer, and will continue them from time to time during our session:

> "In a combined gas and electric light company on what basis should the executive expenses be apportioned * * *?"

Mr. Aldrich—Does that refer to the gross income from both departments?

Mr. Britton—I take it, that the reply means that if the income from the electric lighting service should be $10,000, and the income from the gas department should be $20,000, then the electric lighting service should bear one-third of the executive charges and the gas two-thirds.

Mr. Aldrich—What is meant by "gross income"? The receipts?

Mr. Britton—The total earnings. This question refers entirely to the executive expenses, office expense, officers' salaries, and such other items of expense as cannot be adjusted as between the accounts. The expenses of operation and maintenance can easily be divided. Taxes can also be divided very readily; but certain contingent expenses cannot. It has always been a question as to what proportion each department should bear.

Mr. Philo Jones—I happen to be connected with a company that supplies water, gas and electricity. In apportioning our charges along the line suggested we have arrived at the conclusion that it costs more to operate the water department in proportion to the number of customers than it does to operate the gas and electric departments. In other words, it happens that at the present time our revenue from the gas department is the same as that from the water department, the revenue from the electric department being lower than either; however, we are charging one-half of the executive expenses to the water department.

Mr. Lowe—I want to throw out a suggestion. Mr. Jones may not know it, but he is one of the very few brand new members of this Association who has ever gotten on his feet and has had something to say. He may not be aware of the fact, but it is almost without precedent. Only once before I recollect that a new member got up and "Spoke out in meeting." Every new member should feel that he is one of us. I am very glad indeed to hear new members get up and speak as Mr. Jones has done.

The President—We hope all the new members of the Association will follow the example of Mr. Jones.

The Secretary, the next question is:

> "On what basis would you calculate the advisability of supplying an outlying town with gas and electricity from a central plant * * *?"

Mr. Lowe—Does the answer refer to gross revenue?

Mr. Britton—I do not mind admitting that I answered that question myself. It should have been 60 per cent. per annum gross revenue on the gross cost of installation. I believe that no extension should be considered profitable in such a business as we are engaged unless in the first two years the entire cost of the extension of the plant (so far as refers to the outside extension) should be repaid to the company. You may go into a fairly populous district and get contracts for gas, electricity, or water, if you please, and the prospects may look very promising; but unless you can bind your consumers to a certain revenue of so much per month you are going to be "up in the air." A man may be a very good consumer for the first month, but conditions in his domestic economy may change, and he may be a very poor one a few months later. It does not seem to me right that a corporation such as ours should be called upon to serve a district or population with our commodity, unless we can be assured of a revenue commensurate with the outlay. It is true that we are quasi-public corporations, and under certain obligations to the public; but the law has recognized the fact that we are not obliged to serve under unreasonable conditions, and therefore it does not impose any condition of service that is unreasonable. It is just as well for us to calculate what our revenue is going to be as it is for any man in any other line of business to do so. It seems to me that 60 per cent. of the cost of installation is not too much to expect in 12 months. Suppose you put out $5,000, a revenue of $3,000 is a small amount. You must take out of that your cost of production, maintenance, depreciation, had debts of consumers, etc., and for that reason I do not believe that 60 per cent. is out of the way. I know that some members of the Association have figured it out that they should obtain at least 80 per cent., and a number of contracts have been made on that basis. It does not work any hardship to the consumer, and it does protect the company against uncertain extensions of plant. The losses in the majority of the plants in this State coming under my observation have been due to over-reaching for business in the days of severe competition with electric lighting. And the fact that many of the electric lighting companies paid no dividends was due to their giving no consideration to the proper return of revenue from the investment.

Mr. Aldrich—It always seems to be my unfortunate lot when we get together to come into conflict with Brother Britton. It seems to me that if we are blessed with cities like Oakland, where they have all the business they want, the hypothesis set forth by Mr. Britton would apply; but I am afraid that if we of the younger cities should apply his methods to our business, we should be where the donkey's tail is. In the younger communities we must keep up with the growth of the city. If I did not extend my mains as the districts built up I would very soon have an opposition company in the field. It may perhaps account for some of the large dividends you pay when you tell me that you must have 60 per cent. of the amount spent for mains in revenue the first year. I expect to find Brother Britton and his directors the modern Vanderbilts of the Pacific Coast. I want to say this, gentlemen, that if I could be sure of receiving a revenue of from 10 to 15 per cent. I would very willingly pipe any district at any distance from the works. I think that, with the exception of Mr. Britton's company, or any company that does not require more business, it is a good investment when we can sit down in our offices and figure out that we are sure of 12 per cent. income on the investment. I do not think that 60 per cent. is at all reasonable. I think it is unreasonable. And, if you expect that, I think your consumers ought to come after you to make your gas 60 cents per 1,000.

Mr. Martin—It is clear that the member from Spokane does not thoroughly understand the statement. Mr. Britton's and Mr. Aldrich's statements very largely agree, because Mr. Britton is speaking of 60 per cent. gross revenue on the total investment as being received in one year, while Mr. Aldrich is speaking of 12 per cent. net profit. I think your differences are not very great. One point not brought out by Mr. Britton is that just in proportion as you extend your mains you are drawing from your surplus supply of generating capacity and necessitating a larger investment later on. As a basis for calculation you will find that an income based on 60 per cent. is not too large—that is, a gross income as compared with the cost of installation.

Mr. Aldrich—I would like to ask how you arrive at this 60 per cent. gross revenue. Revenue is something you never receive until your mains are laid and you are selling gas. If anyone wishes to take gas do you expect him to guarantee you a regular monthly payment, say $5?

Mr. Martin—Yes, sir; that is it.

Mr. Aldrich—You are lucky.

Mr. Martin—It is not difficult to meet the requirement. We have had

no difficulty in meeting this requirement in guaranteed revenue in making extensions 2 or 3 miles in length.

Mr. Britton—I am glad Mr. Martin has acted as peacemaker between the two opponents in the Association. I was about to explain that we were not very far apart. In fact, when you take 60 per cent. of the gross revenue and then figure the cost of production and distribution, wear and tear and maintenance, you get down pretty close to 15 per cent. Now, there is a plan we have adopted in making extensions in large territories that works very well. Where a person applies, say at a distance of 300, 400 or 500 feet from the main, we make a calculation upon the actual cost of pipe and labor. That must be paid (and is paid without protest) by the consumer who wants the commodity. We stipulate that he shall receive a rebate of so much for each connection made upon the line of pipe until the total amount paid by him is returned. He is simply advancing the money for the gas company to do business where it is more than a reasonable extension. That, of course, does not apply to cases where the extension is less than 100 feet. As has been suggested, the law compels us to go a reasonable distance; and the Civil Code of this State has fixed that "reasonable distance" at 100 feet from the main.

Mr. Keyes - I have made it a rule to lay a pipe if I can get two consumers in a block who will average $2 a month each; and I have made what I consider a very great success on that basis. It pays, if you can get two consumers in a block, to lay a main at a cost of $360 or $400.

Mr. Lowe—$48 a year gross revenue on $400?

Mr. Keyes—It is natural gas, and is entirely profit. There is no cost of manufacture; only wear and tear on the line. I am inclined to think the conditions are totally different.

The Secretary—Notwithstanding Mr. Britton's motion that we dispense with the roll call, I would like to ask that we have one. Some time ago I was sitting at lunch with the Secretary of one of the city clubs. One of the members of the club came in, and I asked the Secretary who he was. "I don't know," he replied. "I thought you knew everybody in the club," I said. "No, I don't," he answered; "But everybody knows me." I find I am very much in the same position. There are a good many strange faces, and it is difficult to see who is in the hall, so I would like to ask your indulgence for about 5 minutes.

ROLL CALL.

The following members responded to their names:

Adams, H. E.	Gillespie, W. W.	Osborn, W. E.
Aldrich, W. A.	Grimwood, C. P.	Papst, N. M.
Baurhyte, W.	Grimwood, J. B.	Parker, W. M.
Beck, A. C.	Gutsch, A.	Poingdestre, J. E.
Boardman, W. F.	Guthrie, S.	Prutzman, P. W.
Britton, J. A.	Holberton, G. C.	Quilty, C. W.
Burrows, C. E.	Hollidge, G. H.	Rasch, F. A.
Byerly, H. O.	Jones, F. C.	Riffle, F.
Carrigan, A.	Kaneen, J. S.	Ross, A.
Cheffins, E. F.	Keaton, G.	Thomas, J. W.
Clark, O. E.	Keyes, H. C.	Thompson, G.
Clements, J.	Kirk, G.	Thompson, J. R.
Colquhoun, G. S.	Lloyd, A. J.	Thompson, R. J.
Cressey, F. A.	Low, G. P.	Valentine, R. P.
Decker, D.	Lowe, L. P.	Vanderwhite, A. J.
Dole, W. S.	Martin, J.	Weber, H.
Druffel, D. O.	Matthiesen, A. J. P.	Wiester, W. H.
Eichbaum, C. W.	McNeil, J.	Wilson, G. W.
Eichbaum, F. H.	Miller, C. O. G.	
Foveaux, F.	Osborn, M. C.	

Associate Membership Representatives.

Fitzpatrick, F. E.	Kuster, J. D.	Werry, J.
Hoke, J. L.	McPherson, R. T.	

Mr. Hollidge—I would like to ask Mr. Britton another question. Did you say that you charged for the extension and then returned it to the consumer according to the amount that he used each month, until the whole amount was rebated?

Mr. Britton—You misunderstand me. In extensions for a long distance we determine the cost of the installation as nearly as we can. We generally figure it at less than the actual cost. Suppose a man pays us $100 to make an extension. The contract recites that for every consumer coming upon that line he shall be repaid $10; so that when 10 consumers have been obtained and have become consumers of gas the $100 has been returned to him on the installment plan. No difference is made on his gas bill. It is collected every month.

Elected to Honorary Membership.

Mr. Britton—I wish to make a motion. We have in our membership a man who to-day is, I believe, the Nestor of the gas business on the Pacific Coast, a man who has been associated with us ever since the formation of the organization, and who has in the past years been active in its behalf; a man who is one of our honored Past Presidents and who stands high in the gas world. He has given long years of service to his Company (the Pacific Gas Improvement Company), and now, in the turn of Fortune's Wheel, I understand that his position as gas engineer has practically been made vacant (although still retained to some extent upon the payrolls of the corporation). In view of the services of that esteemed member in the past, and as a rightful honor to him in his declining days, I move you that the name of Mr. F. H. Eichbaum, one of our Past Presidents, be placed upon the honorary roll.

[Carried by unanimous rising vote.]

The meeting then adjourned until 2 P.M.

First Day—Afternoon Session.

The meeting was called to order by the President pursuant to adjournment.

Appointment of Special Committees.

The President—Before proceeding with the regular business of the afternoon I will appoint as a Committee for the Nomination of Officers: John A. Britton, of Oakland; C. E. Burrows, of Walla Walla; and Henry Adams, of Stockton.

As a Committee on Obituaries to present suitable resolutions in the matter of the death of Mr. C. E. Burrows, Jr.: Messrs. J. B. Grimwood, R. P. Valentine and J. S. Kaneen. Mr. Kaneen and Mr. Burrows, Sr., were among the pioneer gas men on the Coast and worked together in the 50's. We are now ready to proceed with the regular business of the session. Our first paper will be on the

PRACTICAL PROTECTION OF METAL SURFACES IN GAS PLANTS,

By Mr. L. P. Lowe.

[For the text of Mr. Lowe's paper, see Journal, Aug. 24, 1903, p. 285.]

Discussion.

The President—This is a paper of unusual interest to us all. I would like to ask Mr. Dole to give us some of his experiences in pipe protection in gas works in Maine.

Mr. Dole—The coating we use for service pipe is an asphalt paint. We simply dip the pipe. I do not know whether it is the best thing to do or not. Back East we used a mixture of tar and turpentine, which we found to work very well indeed. As to the lasting qualities of this asphalt paint I do not know. It seems to be all right so far, the work referred to having been done about a year ago. I cannot tell how it will be in the future.

The President—I believe Mr. Beck has had considerable experience with pipe coatings. Perhaps he will give us some of his experience.

Mr. Beck—We do not use very much red lead, though we have used some in construction on the salt water pipes, and on some of the gas mains laid around the new works. Recently I have dug up portions of the pipe, and found them in very good condition. The paint was perfect. This pipe had been in the ground about a year. For the services we use principally an asphalt paint.

The Secretary—Do you mean an asphalt paint, or what we commonly speak of as "tar paint?"

Mr. Beck—What is commonly called tar paint. It is a mixture of crude coal tar and oil tar.

The Secretary—Don't you find the use of crude coal tar inadvisable?

Mr. Beck—We have had no trouble with it so far, and we have been using it ever since the works were started. As soon as we began to manufacture oil gas we adopted the mixture of oil tar and coal tar.

Mr. Osborn—Do you dip your pipe or paint it?

Mr. Beck—We paint it.

Mr. Britton—Perhaps it would be fairer to have Mr. Beck explain the method of coating service pipe more in detail. The pipe is first thoroughly cleansed with a carding cloth which we get from the cotton mills. It is rubbed bright. The pipe is then put on slings and the exhaust from one of the steam pumps then passed through it, one end of the pipe being left open. It is thus heated to a temperature in the neighborhood of 90° or 110°. This mixture of coal tar and oil tar is then applied with a brush. When dry the pipes have a glossy appearance, as if they had been varnished. An experience of 20 years in the use of this coating demonstrates that it is perfectly impervious to the action of soils or of moisture of any sort. I can recall that at one time we took out of the ground some lengths of cast iron pipe, laid possibly a matter of 15 or 20 years, which had been painted with red lead, and every one of these lengths of pipe was evidently just as fresh as it was

the day it was put into the ground. There was no deterioration of any character whatever.

Mr. Aldrich—I agree with the President that the paper read by Mr. Lowe is a very important one; one that we shall all study carefully when we reach our homes. The preservation of property is one of the important factors in any gas plant. But I can see, reading between the the lines, that Mr. Lowe has a "baby" and that that "baby" is red lead. He has not told us anything about its cost. He has not told us how long we are to stand about waiting for it to dry before applying another coat on the surface. Now, to my mind the question of the cost of the paint does not very much affect the case, because the labor used in scraping, cleaning and painting the pipe is the important factor. I think that after your experience with oil gas on the Pacific Coast, it should not be necessary for me to come into your midst and advocate the use of your own ingredients, because I have to send out of town for what I want to paint our holders and other ironwork about our works. I want to take issue with the speaker with reference to the question of red lead as a panacea for the evils of corrosion on our iron structures; and in competition with red lead I want to place a composition which I am sure you will all recognize when I mention it. I may say here that my information was gotten 5 years ago in the rooms of the San Francisco Gas and Electric Company from Mr. Eichbaum, who has just been placed on the list of honorary members; let the younger members take note of what they gain by becoming members of the Association and attending its meetings. I then heard Mr. Eichbaum advocate gas oil tar for the coating of iron structures. Now, with one exception, that is, in my judgment, the finest and best preservative of iron or wood, and in my experience has proved most successful. If you will take a barrel of gas oil tar, dissolve pure rubber in turpentine (it will take several days to dissolve it), and will then mix the dissolved rubber with the gas oil tar (heating it to make a good mixture); then give instructions to your superintendent or foreman of works that your holders shall be thoroughly scraped (the method of cleaning a holder explained in Brother Lowe's paper I heartily agree with—it is the only way to properly clean a holder), and when the holder has been properly cleansed paint it with this composition, I venture to say, without the slightest fear of contradiction, that the holder will last for 5 years at least without the semblance of any necessity for repainting. I have a smokestack (and I suppose they are subjected to the most severe tests possible around gas works) 60 feet high that was painted 3 years ago. That smokestack to-day is apparently in as good preservation as it was the first year the coating was applied. I am not taking exception at all to the red lead. Everybody knows, or ought to know, what red lead is, and I do not take exception because Mr. Lowe prefers it; but I believe you can use the ingredients about your own works, with the addition of a few dollars spent for rubber, and that you will find the expense infinitely less and the results better than if you had used red lead.

Mr. Foveaux—I see that oil tar seems to do very well on ships. A sea captain who was very much interested in the matter applied to me several months ago for a good coating for his decks. I suggested that he try a barrel of oil tar. Since then he has gotten 25 barrels, paints all his iron plates with it, and believes that it gives the best results.

Mr. Parker—At San Jose we use, instead of a brush, a stick with a sack tied to it, introducing steam at one end of the pipe, leaving the other end open. We have painted over 20 miles that way in the past year, and find that it gives a very good coating.

Mr. Aldrich—How do you get under the service pipe?

Mr. Parker—We support it on a pair of horses.

Mr. Lowe—It seems to be my fate to take issue with my brothers. I have not said a word against oil paint; and I am making lots of oil tar (Laughter). But I know red lead is better. In my paper I did mention the fact that red lead was no more expensive. You can figure it out at your leisure for yourselves. Regarding the painting of service pipe with red lead, I believe the way to do is not to wait until the service pipe is ready to be laid in the trench. Paint it beforehand; 6 months beforehand if you want to. Oil tar paint is an excellent one. The use of turpentine in the paint, however, is in my opinion, on a par with taking snow, putting it in milk and imagining you have ice cream.

Mr. Aldrich—The turpentine is used simply to dissolve the rubber.

Mr. Lowe—Leave both the rubber and the turpentine out and the coating will last for 10 years instead of the 5 that you mention. I think the coating of a gasholder painted properly with red lead should stay there for 50 years. You cannot do away with wear and tear and with the effects of the elements; but you can keep your ground work solid for 50 years if properly cared for, and you can do it with no other kind of paint. All the paints are good, but there is only one best.

Mr. Parker—I saw a gasholder taken down in Napa that had been in use for 20 years. It had been receiving a coat of coal tar about once a year, and when it was taken down you could see the bright metal underneath the many coatings.

Mr. Hollidge—We use nothing but oil tar on our stacks, boilers and steam pipes that are exposed, on our brickwork, woodwork, shingles, and in fact on everything at the works, both at the power station and at the gas works. Everything is oil tar from top to bottom. We use nothing else. It preserves the surfaces beautifully. Another thing: We have some sort of microbe that gets into the mortar close to the ground. I do not know whether any of you gentlemen are subject to it. They eat the mortar out of the bricks for about 4 feet above the ground. The oil tar seems to stop their work. The reason I use the oil tar on metals is not because I think it is better than red lead, but simply because it costs nothing except to put it on.

Mr. Lowe—If you were buying a gasholder from a concern in the East, and were asked to specify the paint, what would you say?

Mr. Hollidge—I would specify red lead every time.

Mr. Parker—Would it not be better to have the holders shipped without any paint and put your own paint on afterwards?

Mr. Hollidge—In all the iron vessels built in this country and in Great Britain the first coat received on the iron is red lead. We use the tar only for cheapness.

Mr. Aldrich—Why does the outside of a vessel stink so much of tar then?

Mr. Hollidge—The tar is on top and the red lead underneath. Both the English Admiralty and the Navy Department in our own country use red lead. They would not use oil tar if you gave it to them.

Mr. Lowe—I know it is revolutionary to come into a meeting of gas men and advocate the use of anything but tar. (Laughter.) But I have studied the question pretty thoroughly. At one time I thought it was a good plan to ship out metal work uncoated except for linseed oil to protect it from rusting, but I have changed my views, as if you put paint on top of such an oil coating you have no foundation. Bear this fact in mind, that red lead and linseed oil are the only two paint substances that unite to form a cement, just exactly as Portland cement and water do, and when you have put pure red lead and linseed oil on a structure it becomes a permanent cement.

Mr. Osborn—It seems to have been fully developed that Mr. Lowe's baby is red lead and Mr. Aldrich's rubber.

Mr. Grimwood—I would like to ask if any member can give figures as to the cost of painting pipe. We have heard a great deal pro and con regarding the value of red lead and of tar. Have the members figures as to the cost of painting 2-inch pipe, for instance, giving it a good coat of boiled oil tar or of red lead and oil?

Mr. Lowe—You can figure it out for yourself. Twenty-four pounds of red lead and 5½ pounds of linseed oil will make a gallon of paint. That will cover 400 square feet, two coats. If you spread it out thin it may do 500. I do not know just how much 2-inch pipe a man can paint in a day, but he can do a great many hundred feet.

Mr. Weber—I have had a little experience in painting pipe. I had 3,000 feet of 1¼-inch pipe and 1,000 feet of 1½ inch and 2 inch. I bought two gallons of red lead and oil mixed, and we gave all the pipe two coats, excepting the 2-inch pipe, and that has not been completed. The last time we painted 1,000 feet of 1¼-inch pipe it took two men (who were not painters) 4 hours and 20 minutes. We figured that it would cost about from ⅝ to ¾ cents per foot for 1¼-inch pipe; less for 1½ inch; and probably a little more for 2 inch. As to the time it takes the paint to dry, that would depend entirely on the thickness applied. If it is put on very thin, a second coat can be applied the next day; but if it is done as painters ordinarily paint, it would take from 3 to 4 days before a second coat could be applied.

Mr. Lowe—You could not have had pure red lead and linseed oil.

Mr. Weber That is what it was bought for.

Mr. Lowe—That is exactly the point I was trying to bring out. The paint you used is a self convicted-article.

Mr. Aldrich—As a further contribution to the question of cost I may say that 2 men painted 10 miles of 6-inch pipe and 4 miles of black wrought iron pipe in 1 week; wages, $2 per day.

Mr. Britton—Our expense for painting with tar has been about ½ to $\frac{6}{10}$ cent per foot for 2-inch pipe. That includes cleaning, heating and all. I think the effect of the crude oil tar is lost by the heat in the pipe throwing off all the volatile oil, leaving practically nothing but the asphaltum. Our pipe is always coated far in advance of our needs. It is hauled about in the service wagons after that, but seldom if ever shows any signs of abrasion, even where caught with a pair of tongs. The coating is as hard as enamel, and not at all brittle.

Mr. Lowe—That, of course, applies peculiarly to street pipe; but in

gas works you go a step further. You cannot put steam in a gasholder, nor can steam be applied to construction work. Where you can apply it I know the result is a very excellent pipe coating. I simply maintain that red lead is even better than that. Of course, this applies to only one condtion of affairs and you must consider all of them. My contention is that there can be only one *best* paint

Mr. Osborn—Another point is the fact that all tar paints and pipe are so nearly of the same color that the men are liable to leave some part of the pipe unpainted; and it is hard to tell whether it has been neglected. As you all know, there is no part better than the poorest part. If you have red lead, or white lead, or any lead that gives a contrast of color, you are assured that when you look at a pipe you can tell whether or not it has been painted. A serious defect in the people who furnish us the structural work is their staining the first coat. The stain serves to cover up rust on the sheets. I have in mind a case where I would not allow a priming coat on a 30,000-foot holder; 17 of the sheets were rejected. They would have gone into the holder if there had been paint or stain on them to hide the rust. You can readily understand why some of the sheets give out while the holder is otherwise in as good condition as ever.

Mr. Hollidge—I would like to ask Mr. Britton if he applies his mixture hot or cold?

Mr. Britton—It is put on cold.

Mr. C. W. Eichbaum—Oil tar used on ironwork, especially on the tops of holders, never dries hard. It dries leathery, as far as I have ever seen, and never cracks. If you put on coal tar, or at least some preparations of coal tar, a slight disturbance will crack the coating. Before we used oil tar we used a mixture of Venetian red and oil on all our holders. That also never gets hard, but forms a leathery coating.

Mr. Britton—I would like to ask Mr. Beck what his experience was in painting the crowns of our large holders with oil tar.

Mr. Beck—The holders were painted 3 years ago and the scrubber 10 years ago. They are on exhibition there yet. The oil tar coating is as good as it was the day it was put on.

Mr. Hollidge—Did you mix rubber with it?

Mr. Beck—No rubber. The scrubber stands out in the weather near the salt water, and is as much exposed as any structure could well be. There is no shelter over it whatever.

Mr. Britton—Is it hard?

Mr. Beck—Yes; it is hard. Of course it has taken on a sort of dull black color.

Mr. Britton—Did you put it on hot or cold?

Mr. Beck—It was put on cold, just as it was taken from the well.

Mr. Valentine—I have recently had two large holders in Sacramento scraped down thoroughly so that I could see the actual condition of the metal. As nearly as I could find, they had never had a coating of red lead. The coating of tar was in some cases ¼ inch thick, and the sheets were in perfect condition. There is a third holder I did not dare to have scraped. The paint is all that is holding it together.

Mr. Lowe—If it had had a coat of red lead originally there would have been no trouble.

Mr. Valentine—I had occasion to move a street main a short time ago which had been in the ground about 25 years. It had been coated, I judged, with asphalt or coal tar, and was in perfect condition.

Mr. Clements—I am inclined to agree with Mr. Lowe in the red lead proposition. If you go about in any of the great structures now going up you will find each and every piece coated with red lead. If it preserves the iron in such cases it certainly is the best preservative for gasholders. It would be a very hard matter to convince this particular Association that tar is not right because each and every man has, at some time in his life, used tar; and in a California Association, particularly, it would be impossible to do anything to prevent a man's sticking to tar. A Wisconsin man is called a "Badger," a Californian is a "Tar-head."

Mr. Lowe—Everyone who goes to Chinatown, if he is a tenderfoot, steps into a Chinese drug store and buys a prescription. You pay 25 cents for it. You get a little bear meat for strength, a little race horse for speed, a little sand for grit. You are supposed to take the whole thing. That is exactly the kind of prescription that reminds me of a patent paint; a paint containing, for instance, turpentine and rubber. (Laughter.)

The Secretary—I would suggest in regard to the use of boiled linseed oil and red lead that someone try to build a gasholder of them alone. (Laughter.) I asked in regard to the cost of painting pipe (say 2-inch pipe or sizes close to that) with red lead and oil, and the only replies my question elicited were in the form of statements which required sums in mental arithmetic beyond my capacity. I was trying to get results which I could compare with the results obtained in the use of boiled oil tar with a little turpentine used as a dryer and thinner. I have painted quite a number of miles of pipe ranging about 2-inch, and it cost me about ¼ cent per foot. I do not think you can beat that with red lead and oil. I do not think that the additional advantage in the use of red lead is sufficient to warrant the extra expense. We all have the boiled oil tar. We do not have to buy it. Only a small amount of turpentine is used as a thinning medium to make the tar flow easily. Sometimes it is a good plan to put in a very small amount of boiled linseed oil.

Mr. Lowe—What for?

The Secretary—It has a tendency to make the paint a little less brittle. The less turpentine used the better. If you will mix boiled oil tar properly with small proportions of turpentine for a dryer and thinner, with possibly a little boiled linseed oil, I think you will get as economical and good a paint as you want for your mains and services. When you come to painting metal surfaces above ground, there are other things to be considered.

Mr. Lowe—I would like to ask you a hypothetical question. Suppose the oil tar paint would give you a length of life of 20 years, and the red lead paint would give you a greater length of life, say 30 years; which one would you use?

Mr. Aldrich—Suppose the reverse.

Mr. Lowe—It is purely a hypothetical question. Suppose the red lead to be very much the better paint.

Mr. Aldrich—But it is not.

Mr. Lowe—If the red lead paint gave much better results (irrespective of cost) than the asphalt paint, which would you use?

The Secretary—If the red lead gave better results, I would use it; but I am not ready to admit that.

Mr. Lowe—Assume that it costs more. Take your estimate that it costs ¼ cent to paint 2-inch pipe with oil tar, and assume that it costs ¼ cent to paint with red lead.

The Secretary—You have imposed definite conditions in the question you ask. It is simply a matter of calculating which is the cheaper. If you say red lead costs so and so much and oil costs so and so much, that labor costs a certain definite amount, and that the respective red lead and oil tar paints will last a certain number of years, then it becomes simply a matter of calculation as to which paint is advisable. But we have no definite conditions in practice.

Mr. Lowe—Would not you pay twice as much for red lead as for oil tar if you were satisfied that it would very much outlast it?

The Secretary—I do not see how such a question can be answered.

Mr. Clements—Speaking about it costing the same, you must remember that if the red lead gives your pipe longer life the real cost of the paint would be very much less. The life of your pipe is worth a great deal to you.

Mr. Aldrich—If a gallon of oil tar costs 10 cents and a gallon of red lead paint costs 20 cents, and the oil tar lasts 10 years and the red lead 20 years, the price is the same, is it not?

Mr. Clements—But what about the life of your pipe? The object in putting the paint or tar upon the pipe is to lengthen its life.

The Secretary—The life of the pipe is the life of the paint.

Mr. Lowe—If red lead is the best, use it; if it is not, discard it. It is not a question of the cost of the paint. It is a question of its life.

On motion of Mr. Aldrich the thanks of the Association were extended to Mr. Lowe for his valuable paper.

(To be Continued.)

Variations in the Lighting Power in the Incandescent Burner of Combustible Gases.

By E. Sainte-Claire Deville.

[Abstract translation in *Journal of Gas Lighting* of a paper presented to the International Photometric Committee.]

Reference was made in the report of the Special Correspondent of the of the *Journal* of the proceedings of the International Photometry Committee at Zurich in June to the valuable and exhaustive communication presented to the committee by M. E. Sainte-Claire Deville, the Engineer of the Experimental Works of the Paris Gas Company. We are now able to give in the sequel an abstract translation of this *brochure*, of which the title was: "Variations in the Lighting Power in the Incandescent Burner of Combustible Gases, regarded as a Function of their Calorific Power." It opens with an introduction in which the author describes the aim of his work, the general scheme of his investigations, and the order in which they are reported in the

paper. A summary of this introduction has already been given; but, for the sake of completeness, we reproduce it here, and follow it by the several parts of the paper in their original sequence.

The question of the illuminating power developed by incandescent burners must be looked at from two entirely different points of view: (1) Given a mantle of definite composition and dimensions, how does its lighting power vary when gases of different compositions are burnt under it? (2) Given a particular unvarying gas, how does the lighting power vary when it is burnt under mantles differing in mode of manufacture or in composition? That is to say, the study of the photometry of incandescent lighting entails a distinction being drawn between the photometry of the gas and the photometry of the mantle.

It is well known that the illuminating power of ordinary gas flames is not a regular function either of the specific gravity or the calorific power of the gas; and empirical methods, based on certain definite conventions, have been adopted for the determination of this illuminating power, which arises from the carbonaceous particles suspended in the flame. But the conditions are totally altered when the incandescent mantle is employed. Every gas which yields heat on its combustion, can likewise yield light. Further, it seems fair to assume that for a given quantity of heat expended in a given time under a particular mantle, the same quantity of light will be obtained whatever may be the composition of the gas used. Thus the value of different gases per unit volume would vary inversely with the volume required to yield a given amount of heat; in other words, it would be proportional to the heat of combustion of a cubic foot of the gas. But there is one serious objection to this theory—viz., that the brilliancy of a mantle depends primarily upon the temperature of the flame by which it is heated. Some gases yield a hotter flame than others, even when the heat expended remains the same. The question is, does this peculiarity play an important part in practice, and is it a question which only experience can answer? The author has worked at intervals, since the beginning of 1898, with the object of solving it. His studies have led him to the conclusion that the theoretical temperature obtainable by the combustion of a gas is a negligible factor in all ordinary cases, and that consequently the heat of combustion remains the principal and essential criterion of the value of any gas so far as its use for incandescent lighting is concerned. The author, therefore, thinks there is no occasion to agree upon international rules for the photometry of gas employed in incandescent lighting. On the other hand, the photometry of mantles will only be practically serviceable in the future when it is carried out according to uniform rules, which will insure results comparable with one another being obtained in different countries.

The paper embodies three sections, of which the first reproduces, with small verbal changes, an unpublished account, from records of the experimental gasworks at Paris, dated March 25, 1901, of a "Study on the Intensive Combustion in the Welsbach Burner of Coal Gas of Widely Different Qualities." The second is similarly a reproduction of an unpublished record on "The Measurement of the Illuminating Power of Gas in Incandescent Lighting, and a Definition of a Rational Mode of Photometry therefor" (dated June 22, 1901). The third section presents a summary—specially prepared for the meeting of the committee—of (*a*) some observations made in and after the second week of 1901 to supplement those quoted in the second memoir; (*b*) the two memoirs which constitute the first and second sections; and (*c*) a dissertation on the same questions, dated Dec. 18, 1894, and of too great length for reproduction in its entirety. Finally, the whole matter is discussed; and the conclusions as to the determination of the illuminating power of the gas in incandescent lighting, and that of the mantles, are stated.

[*Note by Translator.*—It has been impossible to give equivalents of the phometrical measurements recorded in this communication in terms of English standards and measures, for reasons which will be apparent from the following statement of the relations between the methods of photometry in common use in France and England: The standard of light in France is the carcel lamp, the intensity of which is, on an average, equivalent to the light of 9.5 English sperm candles.[1] The gas to be tested is in France burnt in the bengel gas burner at the rate required to yield a light exactly equal in intensity to one carcel, and the illuminative value of the gas ascertained in this way is expressed by stating this rate of burning in liters per hour. There are 28.3 liters in a cubic foot. There is no fixed ratio between the light afforded by the bengel burner and that given by the London Argand when the same gas is burnt in them at the same rate of consumption. The ratio varies with both the quality of the gas and the rate of consumption, and has not been established for different conditions.[1] In England, the gas to be tested is consumed in the "London" Argand burner, with a chimney of suitable size, either at the fixed rate of 5 cubic feet per hour, or at the rate required to yield a light of 16-candle power. Apart from the different illuminating duty afforded by the bengel and "London" Argand burners, comparisons between results obtained by the French and English methods of photometry cannot be fairly made, because, on the one hand, the rate of consumption required to yield a light of one carcel in the bengel burner is rarely so high as 5 cubic feet (141.6 liters), while, on the other, there is no established relation between the rates of consumption required to yield a light of 16-candle power in the "London" Argand burner, and a light of 9.5-candle (1 carcel) power in the bengel burner. Consequently, translation of the photometrical measurements here recorded into English terms is out of the question; and the measurements must be considered only as comparable between themselves. With regard to the results of testings of calorific power, they are stated in "calories per cubic meter" (or occasionally, in "calories per liter"). One calorie per cubic meter is equal to nearly 0.1124 British thermal unit per cubic foot.]

I.—*On the Combustion of Coal Gas of Widely Different Degrees of Richness in the Welsbach Burner.*—If an ordinary No. 1 Welsbach burner, of which the apertures for the entering of gas and air have been adjusted by the maker to suit the average gas of Paris, is taken, and supplied successively with samples of coal gas gradually increasing in richness, and having the following characteristics,[2] the results shown below are obtained:

No.	Lighting Power (Bengel.) Liters.	Density.	Heat of Combustion. (Calorimetric Bomb.) Gross. (Water Condensed.) Calories.	Heat of Combustion. (Calorimetric Bomb.) Net. (Water as Steam.) Calories.
1	156.26	0.2986	4,606	4,181
2	117.85	0.3751	5,498	5,007
3	104.65	0.3887	5,755	5,250
4	97.78	0.4239	6,220	5,691
5	80.29	0.4987	7,062	6,489

If, during the photometric test, the consumption of gas is regulated by the cock of the meter so as to produce the maximum of light, the normal consumption, such as a careful consumer would be likely to incur, is arrived at. Working under these conditions, it is found that as we pass from No. 1 to No. 5, the consumption of gas continues to diminish (from 95.8 to 50.5 liters). The heat evolved per hour—*i. e.*, the net heat of combustion of the volume of gas—likewise decreases from 400.7 to 327.5 calories. As regards absolute luminous intensity, it falls to 3.07 carcels for the richest gas from its maximum of 4.09 carcels for the poorest gas. The useful lighting effect for equal volumes of gas increases as follows:

	Poor Gas	Rich Gas.
Intensity per 100 liters of gas.....	4.27 carcels	6.07 carcels.
Or inversely—		
Consumption per carcels	23.4 liters.	16.5 litres.

Lastly, the useful lighting effect per unit of heat evolved—*i. e.*, the intensity of light per 1,000 calories net—ranges from 10.2 carcels for the poor gas to 9.3 carcels for the rich gas.

These figures must not lead to the supposition that the poor gases are more advantageous than the rich ones for incandescent lighting; for both rich and poor were tested in one and the same burner. If each gas is consumed in the burner best suited to it, or if, more simply, a burner is provided in which the quantities of air and gas can be adjusted to each other, it will be found that for quantities corresponding to a consumption of 300 to 400 calories per hour the maximum luminous intensity remains proportional to the heat produced. The quantity of air they require can by these means be supplied to rich gases at the base of the bunsen; and under these conditions they give, per 1,000 calories, the same results as poor gases. In other words, for the same volume used, the illuminating effect is proportional to the heat liberated by the gas consumed. Thus, in the ordinary use of the Welsbach burner, the luminous return for the heat produced may seem greater for poor gases; but this is due to the fact that at the usual pressure the burner does not treat the rich gases properly, supplying them with insufficient air.

To sum up, the experiments made in 1894 enable one to conclude that, in principle, the different gases produce the same quantity of light

1 See *Journal*, Vol. LXXXII., p. 957.

1. *Ibid.*, p. 443.

2. Each gas was a product of the distillation of coal. The poorest were drawn off towards the end of working off a charge; the richest at the commencement. Each line in the table represents the mean of 7 or 8 samples of gas, all of practically the same degree of richness.

for the same production of heat in the Welsbach burner; in other words, the luminous effect obtained in proportion to the volume burnt is proportional to the heat of combustion of the gas, assuming always that each gas is burnt with the proportion of air at the base of the bunsen which best suits it. It must be added that these generalizations have been established experimentally only for small burners, in which the consumption of heat does not exceed 350 to 450 calories. The author considers it probable that experiments made in Germany, and alleged to indicate that coal gas enriched with benzol is less favorable in the Welsbach burner than the same gas unenriched, are nothing more than a repetition of the first of the two series of experiments just mentioned. Had air been artificially supplied, as was done in the second of the series, to the enriched gas, it would have been found that its lighting power in a Welsbach burner is superior to that of the unenriched gas for equal volumes, and for the same quantity of heat produced.

With regard to the influence of temperature on the combustion of gas, at the time Herr Oechelhaeuser's Inaugural Address at the Cassel meeting of the German Association of Gas and Water Engineers drew attention to this point, Dr. Strache, of Vienna, announced that water gas, burnt pure in his patented burner, supplied a quantity of light almost as great, for equal volume, as did coal gas, and therefore double for equal production of heat. These facts suggested to certain minds the idea of a plausible theory couched somewhat in the following terms: Water gas and its components, hydrogen and carbonic oxide, possess a temperature of combustion distinctly higher than that of coal gas. Now, as the brilliancy of Welsbach mantles depends essentially—other things being equal—on their temperature, it is not the heat of combustion of the gas which is the chief factor in the brilliancy of the mantle, but the temperature of combustion. Hence there is no need for surprise that water gas gives a better result than coal gas. One can even assume also that the poor coal gases, which are rich in hydrogen, have a higher temperature of combustion, and therefore are more efficient for incandescent purposes than rich gases. [It will be seen farther on that this hypothesis is incorrect, although at first sight it seems plausible enough.] This hypothesis has something seductive about it. But it must be remembered that, in practice, *the temperature of the mantle remains much below the theoretical temperature of the flame.* In reality, were the mantle to reach the theoretical temperature in the case, for example, of an ordinary No. 1 Welsbach burner producing 450 to 500 calories per hour, it would be impossible to obtain, with the same gas, a greater luminous intensity, since no increase could be made in the temperature of the mantle.

Now, experience proves that this same No. 1 burner, giving 4 carcels for an hourly consumption of 400 calories, can be raised to an intensity of 28 carcels—*i. e.*, seven times as great—by pushing the supply of air and gas to its extreme limits; that is to say, by effectively increasing the consumption to from 1,500 to 1,600 calories per hour.

Thus, if it is wished to emphasize the true influence of the theoretical temperature of the combustion of the flames of different gases, it is necessary to work under the most intense conditions. The course of experiments suggested in this direction is evidently as follows: Take the complete series of gases—hydrogen, carbonic oxide, water gas, coal gas, very poor, poor, average and rich. Measure or calculate for each gas, as is best suited in each case, the following constants: Heat of combustion, density, ordinary lighting power, composition and theoretical temperature of combustion. Then produce, with each gas and under the same mantle, flames rising in intensity—a burner fed by artificial air being used. For example, given a gas of 5,000 calories per cubic meter, the consumption of gas will be fixed successively at—

About	100	liters (say)		500	calories	per hour	(*a*)
"	150	"	"	750	"	" "	(*b*)
.....	.....						
"	400	"	"	2,000	"	" "	(*n*)

For each case *a b . . . n*, the consumption of air will be regulated in such a manner that it is impossible afterwards to alter it one way or another without reducing the luminous intensity. This done, the photometric test is made, and the output of gas and heat noted, as well as the quantity of air supplied to the bunsen, and the luminous intensity of the mantle. This latter will increase on passing from *a* to *b*, from *b* to *c*, and so on, but a point will be reached at which it attains an upper limit beyond which it cannot pass. It seems reasonable to assume that this instant coincides with that when the mantle reaches equilibrium, as regards temperature, with the flame.

Now, it is impossible to carry out such a series of experiments in an ordinary burner, as the composition of the gas, whether rich or poor, modifies the conditions under which an explosive mixture is formed at the base of the burner. With very poor gases (below 3,000 calories per cubic meter), lighting back at the base takes place before the maximum intensity of the flame is reached. For such reasons as these, no doubt, Dr. Strache has used an actual Argand burner for pure water gas; the air and gas meeting in the cavity of the mantle. But such an arrangement cannot insure a sufficiently intimate mixture of the air and gas. This fact is mentioned to explain why the experiments detailed below do not include water gas and very poor coal gas. The trials must be restricted to coal gas rich enough to be efficiently used in a No. 1 Welsbach burner.

The 5 series of experiments were all made with different mantles. Each series included 2 sets of photometric tests. The first consisted of a simultaneous and comparative trial (other conditions remaining the same) of a poor gas and a rich gas. The two experimental gasholders were filled, one with rich gas taken at the commencement of working off a charge of coal, and the other with poor gas taken at the end of the working from the same retort. With these two gases, the twe series *a b . . . n*, as above, were undertaken, first with the rich gas and immediately afterwards with the poor gas. The second test consisted of a trial of the average gas throughout a make. The following day the same series of operations were repeated with the same mantle, and the average gas produced from the same coal.

Five complete series were made, each with a different mantle and coal. The results were then condensed into a single series of figures by the aid of graphic methods and averages—the 5 poor, the 5 medium and the 5 rich gases being taken in 3 separate groups. The results of only the poor and rich gases are given below. The constants of the two gases were:

	Mean of 5 Poor Gases. Liters.	Mean of 5 Rich Gas.s. Liters.
Consumption per bengel-carcel (10°C. and 760 mm	288.8000	76.6200
Density of the dry gas (0° and 760 mm.	0.3161	0.5344

The composition of the gases was—

Benzene vapor	0.770	1.346
Propylene	0.000	2.912
Ethylene	0.624	3.782
Methane	23.878	44.066
Hydrogen	64.642	36.560
Carbonic oxide	7.252	7.280
Carbonic acid	1.434	2.654
Nitrogen	1.000	1.000
Oxygen	0.400	0.400
	100.00	100.00

The heat of combustion per cubic meter of gas (constant pressure) was—

(1) Observed by a Junkers calorimeter per cubic meter at 10° C. and 760 mm—

	Calories.	Calories.
Water condensed	4,475	6,912
" as steam	4,072	6,346

(2) Per cubic meter of dry gas, at 0° and 760 mm. (water as steam)—

Observed	4,302 (100.0)	6,719 (100.0)
Calculated from analysis	4,354 (101.2)	6,670 (99.2)

	Liters.	Liters.
Volume of gas (10° C. and 760 mm.) producing 100 calories on combustion (water as steam)	24.56	15.76
Volume of air required for complete combustion of 100 liters of gas	439.30	695.30
Volume of total products of combustion of 100 liters of gas	503.10	775.00

Combustion of products of complete combustion—

	Per Cent.	Per Cent.
Nitrogen	69.34	71.17
Water vapor	23.03	18.72
Carbon dioxide	7.63	10.11
	100.00	100.00
Theoretical temperature of complete combustion, calculated by Le Chatelier's method	1,949° C.	1,950° C.

Passing now to the table below, the luminous intensities given therein correspond to amounts or consumptions of heat rising from 500 to 1,600 calories. In regard to these figures, it should be noticed that with the poor coal gas a higher absolute intensity can be reached than with the rich gases. While an ordinary Welsbach No. 1 burner has been

ible to produce up to 30.77 carcels with a poor gas, more than 24 carcels cannot be obtained with a rich gas. The mean of the maxima for the 5 mantles was 27.5 carcels for the 5 poor gases, and 20.44 carcels for the 5 rich gases. The mantles used had an apparent area (area of the vertical projection of the luminous part of the mantle) of about 12 square centimeters; and the mean brilliancy was 2.3 carcels per square centimeter for the poor gases, and 1 7 carcels for the rich gases. These observations prove that the combustion of the poor gas can raise the mantle to a higher temperature than the combustion of the rich gas, and that, whatever may be the theoretical temperature of the flames of the poor gases, it is not higher than that of the rich gases. The two figures already given are 1,949° and 1,950° C. This item must be borne in mind in the sequel.

TABLE I.

	Consumption per Hour.		Luminous Intensity in Carcels.			Volume of Air per 100 Liters of Gas.*	Gas Consumed per Carcel, in Liters.
	Gramme-Calories.	Liters of Gas.	Absolute.	Per 1,000 Calories per Hour.	Per 1,000 Liters of Gas.		
Poor Gases.	500	122.8	6.42	12.85	5.228	340	19.13
	600	147.4	9 06	15.10	6.146	356	16.27
	700	171.9	11.62	16.60	6.760	370	14 79
	1,000	245.6	18.62	18.62	7.581	382	13.19
	1,300	319.3	23.79	18.30	7.451	383	13.42
	1,500	368.4	26.37	17.58	7.158	383	13.97
	1,600	393.0	27.52	17.20	7.003	383	14.28
Rich Gases.	500	78.8	6.70	13.40	8.504	539	11.76
	600	94.5	9.10	15.17	9.627	570	10.37
	700	110.3	11.48	16.40	10,420	595	9.76
	1,000	157.6	17.20	17.20	10.915	618	8.16
	1,300	204.9	20.21	15.55	9.868	617	10.13
	1,500	236.4	20.25	13.50	8.567	616	11.57
	1,600	252.1	19.68	12.30	7.806	615	12.81

* Volume of air mixed with the gas at the base of the Bunsen burner in order to obtain he maximum intensity from the gas.

[To be Continued.]

Rise of Effciency in Electric Stations.

By Mr. ALTON D. ADAMS, in *Elec. World.*

Efficiency of electric stations has made a marked advance during the past decade. To prove this proposition for stations in Massachusetts two classes of data are available, namely, the prices and incomes from sales of electrical energy on one hand and the capacities of lamps and motors supplied, with the weights and costs of fuel consumed on the other. Before 1896 figures for the cost of fuel in all the stations of the State are not available, but the costs of station operation in prior years give an indication of the relative costs of fuel. The truth of this last statement may be gathered from the fact that in the fiscal year of 1896 the cost of fuel for all stations under private ownership was 44 per cent. of their total cost of operation. For the year of 1890 the cost of operation at all of these stations was 39 per cent. of their income from sales of electrical energy, but for 1895 the corresponding per cent. declined to 35.

Energy Incomes and Costs of Operation for all Stations.

Year Ending June 30.	Energy Incomes.	Costs of Station Operation.	Per Cent. Operation Costs to Incomes.
1890.....	$1,908,394.00	$752,831.18	39
1891.....	2,432,869.15	1,014,242.88	41
1892.....	2,947,199.64	1,156,320.69	39
1893.....	3,427,576.84	1,376,946.15	40
1894.....	3,623,056.92	1,389,187.27	38
1895.....	3,794,060.41	1 358,689.83	35

From these figures it is hard to avoid the conclusion that the proportionate outlay for fuel declined rather than rose during the period. Beginning with 1896, the cost of fuel is separate from other items, and in that year this cost was 15.54 per cent. of the total energy income of all the private stations. The next 3 years each show a reduction of this per cent., and there was a slight rise to 14.18 in 1900. This corresponds to a reduction of 9 per cent. in the ratio of fuel cost to energy income during the period.

Energy Incomes and Costs of Fuel.

Year Ending June 30.	Total Energy Income.	Cost of Fuel.	Per Cent. Fuel Cost to Energy Income.
1896.....	$4,148,681.71	$644,996.91	15.54
1897.....	4,467,146.60	693,479.59	15.52
1898.....	4,775,316.07	673,026.98	14.09
1899.....	5,046,412.75	702,925.20	13.92
1900.....	5,622,556.43	797,743.73	14.18

The two sets of figures just presented show a small decrease in the ratio of fuel cost to energy income during the decade under consideration. Assuming the cost of fuel per unit of heating capacity to have been constant during this period, the efficiency of electric stations must have risen slightly if prices were the same throughout. If average prices rose greatly, the general efficiency must have declined. If prices fell, the average efficiency advanced. At one of the largest inland stations of the State the average prices paid for coal in each year were:—In 1892, $3.43; 1893, $4.14; 1894, $4.43; 1895, $4 07; 1896, $3.97; 1897, $4.29; 1898, $3.67; 1899, $3.75; 1900, $4.39 per ton. At a large station on tide water the prices were:—1895, $3.17; 1896, $3.35; 1897, $2.77; 1898, $3 13; 1899, $3.

Evidently these prices for soft coal, the principal fuel, did not cause the decline in ratio of fuel cost to energy income. Commercial prices per unit of energy sold by electric stations during the past decade cannot be accurately determined from the data at hand. It is possible, however, to show very clearly what the general movement of these prices has been during the period. One of the means by which a conclusion as to relative prices can be reached is found in a comparison of the total income from sales of electrical energy in each year with the dynamo capacities of electric stations in the same year. The table shows that for each kilowatt of dynamo capacity in electric stations of Massachusetts for the fiscal year of 1890, an income of $125.12 was received from sales of electrical energy during the year. For 1892 this income rose to $139.09, but since that year there has been a constant and rapid decline in its amount. This decline is not due to any falling off of the amount of energy sold, for the energy income of 1892 was only 52 per cent. of that of 1900. During the fiscal year of 1900 the energy income of electric stations per kilowatt of dynamo capacity was $81.51, or only 59 per cent. of the like income for 1892. Unless the condions of electrical supply were much more adverse in 1900 than in 1892, this change of income seems to indicate a large reduction of prices. It may be suggested that the ratio of dynamo capacities to maximum loads has increased with the general improvement of electric stations, but it is at least equally true that average loads have gone up faster than maximum loads, due to the rise of electric motive power and the extension of day lighting in business houses. It can hardly be maintained that dynamo capacities have increased sufficiently, relative to the average load, to reduce the income per unit of capacity by 41 per cent. The only other conclusion is that of a reduction in price. The income figures thus far given are for both commercial and public lighting, but it can be shown that price reductions have taken place as to each sort of service. Beginning with the fiscal year of 1896, it is possible to divide the total energy income into the parts received for service to commercial arc lamps, commercial incandescent lamps, public arc lamps, public incandescent lamps and for electric power.

Energy Incomes of Electric Stations per Kilowatt of their Total Dynamo Capacity.

Year Ending June 30.	Kilowatts Dynamo Capacity.	Total Energy Income.	Total Per Kilowatt Capacity.
1890	15,244	$1,908,394.00	$125.12
1891.....	18,593	2,432,869.15	130.84
1892.....	21,188	2,947,199.64	139.09
1893.....	26,953	3,427,576.84	127.16
1894.....	31,749	3,693,056.92	116.32
1895.	33,256	3,794,060.41	114.08
1896.....	40,226	4,148,681.71	103.13
1897.....	45,461	4,467,146.60	98.26
1898.....	50,490	4,775,316.07	94.57
1899.....	63,020	5,046,412.75	80.07
1900.....	68,941	5,622,556.43	81.55

For the fiscal year of 1896, 11,100 public arc lamps were operated by electric stations at a total price of $1,170,627.73, or an average of $105.46 per lamp. The like average was less in each year thereafter, and in 1900 amounted to only $99.17 per lamp. This represents a reduction in price of 6 per cent,

Incomes and Prices of Public Arc Lamps.

Year Ending June 30.	Number Public Arc Lamps.	Income From Public Arc Lamps.	Average Price Per Lamp.
1896.....	11,100	$1,170,627.73	$105.46
1897.....	11,695	1,179,197.17	100.83
1898.....	12,104	1,247,708.61	103.08
1899.....	13,092	1,278,571.07	97.66
1900.....	13,462	1,335,103.02	99.17

Public incandescent lamps are a comparatively unimportant item,

and the total income derived from them is only about one-fourth of the like income from public arc lamps.

Incomes and Prices of Public Incandescent Lamps.

Year Ending June 30.	Public Incandescent Lamps.	Income from Public Incandescent Lamps.	Income Per Lamp.
1896.....	13,307	$252,393.03	$18.89
1897.....	14,834	292,492.01	19.71
1898.....	15,632	319,671.36	20.45
1899.....	15,980	320,706.55	20.06
1900.....	17,611	336,593.11	19.11

Between 1896 and 1900 the income of electric stations per public incandescent lamp varied but little, having been $18.89 in the former year and $19.11 in the latter, an increase of 1 per cent.

Turning to commercial service, a much more rapid reduction of prices is notable than that found for public lamps. Commercial arc lamps numbered 7,614 in 1896 and the average income from each was $68.57. In 1900 there were 9,893 of these lamps and the average income per lamp was $53.81. The latter year thus shows a reduction as to the former of 21 per cent. in the average price per lamp in use.

Incomes from Commercial Arc Lamps.

Year Ending June 30.	Commercial Arc Lamps.	Income from Commercial Arc Lamps.	Income Per Lamp.
1896.....	7,614	$522,105.08	$68.57
1897..... ...	7,834	575,834.23	73.50
1898.....	7,743	564,593.82	72 91
1899.....	8,161	529,450.80	64.87
1900.....	9,892	533,374.29	53.81

In this connection it may be noted that for the year of 1896 each public arc lamp yielded a revenue of 53 per cent. greater than the revenue from each commercial arc lamp, on an average. For 1900 the average revenue from each public arc was 84 per cent. greater than that from each commercial arc. Commercial income per connected incandescent lamp, like that per arc, shows a material decline between 1896 and 1900.

Incomes from Commercial Incandescent Lamps.

Year Ending June 30.	Commercial Incandescent Lamps.	Income from Commercial Incandescent Lamps.	Income per Lamp.
1896.....	535,072	$1,687,255.58	$3.15
1897.....	648,139	1,828,844.28	2.82
1898.....	743,266	2,006,414.96	2.69
1899.....	851,742	2,190,493.10	2.57
1900.....	973,579	2,580,019.28	2.64

Commercial incandescent lamps to the number of 535,072 yielded an average income of $3 15 each in 1896, and 973,579 of thesse lamps earned $2.64 each in 1900. These figures show a decline of 16 per cent. in the income per lamp for the period. Each public incandescent lamp yielded an average revenue 500 per cent. greater than each commercial incandescent lamp for the year 1896, and for 1900 this per cent. rose to 624. Electric motors as well as lamps show a decided reduction of commercial income per unit of capacity during the period under consideration. For 1896 the rated capacity of motors supplied from electric stations was 13,930-horse power, and the average income per horse power from these motors was $37.13.

Incomes from Electric Motors.

Year Ending June 30.	Horse Power of all Motors.	Income from Electric Power.	Income per Horse Power.
1896.....	13,930	$517,300.29	$37.13
1897.....	16,318	590,778.91	36.20
1898.....	18,930	636,927.32	33.64
1899.....	22,740	727,182.23	31.95
1900.....	27,133	838,466.73	30.90

In the year 1900 electric service to motors of 27,133 aggregate horse power yielded an average income of $30.90 per horse power. The income per unit of connected capacity for electric motors was thus 17 per cent. less in 1900 than in 1896. Public lighting as a whole during this period yielded a declining income per unit of energy capacity in the lamps supplied, because the fall of 6 per cent. in the average earnings per arc more than offsets the rise of 1 per cent. in the average earnings of each public incandescent lamp. This reduction of income per public lamp, and, in commercial service, a fall of 17 per cent. per horse power of motors, 16 per cent. per incandescent lamp and 21 per cent. per arc lamp, in average yearly revenue, seem to point to lower prices for energy all along the line. Against such a conclusion it can only be urged that the average hours of service from each lamp and motor per year have decreased during the period. Just the reverse of this is probably true, however, as it is a matter of general observation that the tendency has been for the daily periods of service from street and private lamps and from motors to increase. It follows that prices have fallen at least as rapidly as the income per unit capacity in lamps and motors supplied. While the ratio of fuel cost to energy income has declined more than 9 per cent., the energy income per kilowatt capacity of dynamos in electric stations has grown smaller by 41 per cent., and like income per unit of capacity in connected lamps and motors has shrunk from 6 to 21 per cent. All this argues a substantial increase of efficiency. Results thus far relate to all of the electric lighting stations of the State under private ownership, and show merely the average result. As many stations may have failed to make material advances in efficiency, particularly in small places, it is probable that the best stations have done much better than just indicated. Massachusetts contains 33 cities. In three of these the electrical supply is derived from stations in other cities. Two cities operate public electric plants. Water power is used in connection with electric stations in three cities. Of the 25 remaining cities, 24 have only one electric lighting system each, and one, Boston, has several such systems. Two of the electrical systems at Boston and the single system in each of the other 24 cities are here considered to determine their changes of efficiency during the past decade. The first step in this direction is to find the yearly energy income at each city per ton of coal consumed by its electric lighting system. Coal is stated in long tons of 2,240 pounds each. Small amounts of coke have been used in some plants, and this coke is included with the coal on the basis of 2,000 to the ton. In instances where screenings have formed a part of the fuel, only 85 per cent. of their weight has been added to that of the coal. For each electrical system the income derived exclusively from sales of energy in each year has been divided by the corresponding number of tons of coal. Each electrical system is designated by the name of the city in which it is mainly located.

Energy Incomes of Electric Stations in Dollars per Ton of Coal Burned.

Stations.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.
Boston Edison..	23.89	20.85	25.17	30.63	32.12	32.23	29 57	26.20	28.75
Boston Electric.	21.48	24.47	23.91	23.81	23 21	23.65	22.53	21.15	31.24
Lowell	32.83	22.39	24.07	20.44	24.14	24.50	17.16	21.22	21.90
Cambridge.....	18.22	21.16	21.60	21.82	19.81	19.55	21.77	22.36	24.59
Pittsfield	17.54	17.06	15.95	14.69	13.64	12.32	14.26	13.98	12.75
Fall River.....	29.61	34.02	33.16	32.02	32.77	28.57	27.27	27.16	29.00
Worcester. ..	39.56	33.08	34.78	32.63	35.86	38.25	40.28	40.38	44.40
Somerville.....	19.34	37.27	23.17	19.57	22 76	21.83	23.07	22.57	22.07
Lynn	34.38	32.15	35.12	37.93	39.27	37.29	37.31	34.78	32.69
Salem	18.75	18.45	18.71	21.02	21.32	24.43	23.71	21.70	22.19
Brockton	22.92	20.87	18.57	16 01	20.28	18.74	18.29	18.43	19.61
Chelsea.....	25.20	22.17	20.10	18.55	18.23	16.37	15.04	17.09	17.32
Newton.....	15.27	11.13	13.51	14.67	90.61	13.39	15.46	14.26	16.66
Waltham.....	13.57	17.56	16.12	14.51	13.83	12.76	14.39	14.28	14.64
North Adams..	25.13	17.76	21.76	20.18	18.51	13.72	14.35	16.05	15.12
Woburn.....		13.37	14.39	12.28	12.82	11.60	8.36	11.43	18.62
Malden.....	28.77	18.43	26.37	22.82	24.31	22.84	24.88	24.53	25.45
Haverhill	18.26	51.10	28.35	13.77	25.32	24.71	27.57	26.21	30.61
New Bedford ..	17.58	17.32	22.39	24.65	25.21	26.18	42.23	24.05	32.31
Fitchburg.....	26.93	24.99	31.00	25.14	23.68	24.17	25.34	28.46	29.81
Northampton ..	19.51	24.04	20.63	19.38	17.92	20.08	20.45	20.71	18.46
Quincy	15.01	14.67	14.51	14.68	17.46	19.58	19.96	19.10	20.46
Gloucester....	23.81	17.49	14.72	17.52	15.91	22.17	19.36	22.38	24.25
Beverly	30.88	32.09	34.98	33.26	42.94	15.53	15.57	16.97	36.07
Marlboro.....	26.12	26.68	23.38	21.37	21.67	21.69	22.32	22.05	24.63
Newburyport ..	30.26	36.71	27.75	23.49	24.54	6.38	21.67	23.44	33.10

A glance at the table shows great diversity of results; in some systems the income per ton of coal has remained nearly constant; in others it has largely increased, and in still others it has materially declined. Good examples of nearly constant incomes per ton of coal, looking at the entire period rather than at fluctuations in single years, are found in Lowell, Fall River, Lynn, Somerville, Newton, Waltham, Brockton, Northampton and Marlboro, a total of 9 cities. In 5 cities there has been a decided decrease in the energy income per ton, namely, in Pittsfield, Chelsea, North Adams, Beverly and Newburyport. Twelve plants, namely, the Brockton Edison, Boston Electric, Cambridge, Worcester, Salem, Woburn, Haverhill, New Bedford, Quincy, Gloucester, Malden and Fitchburg, have yielded a substantial gain in the income per ton. As a rule, the incomes per ton of coal for each system are consistent from year to year, and show only such changes as may readily be due to fluctuations in prices or to improvements of efficiency. There are, however, a few figures for incomes per ton that seem to be due to errors in the original reports as to the tons of coal burned in cer-

tain years. Incomes per ton that are probably incorrect are those at Lowell, Worcester and Malden in 1892, at Somerville, Haverhill and Newburyport in 1893, at Newton and Beverly in 1896, at Woburn and New Bedford in 1898, at Newburyport in 1897, and at Beverly and Newburyport in 1900. Reports for the weight of coal from 26 stations during 9 years involve 234 separate quantities, and the 11 reports that appear incorrect constitute only 5.5 per cent. of the total. In general it may be fairly said that these figures as to incomes per ton of coal carry on their face evidences of truth, when considered with the known facts of electrical supply. It is of interest in this connection to know that the figures for fuel consumption are sworn to by the officers of electric corporations, as required by law, and a willful misstatement is perjury.

Of the 26 electric lighting systems above considered, 9 are owned by gas companies, namely, those at New Bedford, Lynn, Newton, Fitchburg, Chelsea, North Adams, Waltham, Beverly and Newburyport. The remaining 17 lighting systems are owned by purely electric corporations. Of these 9 gas companies that operate electric lighting systems, those at Chelsea, North Adams, Beverly and Newburyport, or 44 per cent. of their totals, show a decided decline of energy income per ton of coal during the decade. The gas companies at Lynn, Newton and Waltham, or 33 per cent. of the total, have held their income from electrical energy per ton of coal at a fairly constant figure. Two gas companies, those at New Bedford and Fitchburg, or 22 per cent. of those operating electrical systems, have made decided gains in their energy incomes per ton of coal. Of the 17 purely electric systems, the Boston Edison, Boston Electric, Cambridge, Worcester, Salem, Woburn, Haverhill, Quincy, Gloucester and Malden plants, or 58 per cent. of the total, have earned a rising income per ton of coal during the decade. The plants at Lowell, Fall River, Somerville, Brockton, Northampton and Marlboro, being 35 per cent. of those that are purely electric, have maintained a nearly constant energy income per ton. Only one purely electric plant, that of Pittsfield, representing 6 per cent. of the 17, has suffered a decided loss in energy income per ton. While 58 per cent. of the purely electric companies have gained in energy income per ton, only 22 per cent. of the gas companies have made similar gains. While 44 per cent. of the gas companies have lost in energy income per ton, only 6 per cent. of the electric companies have made a similar loss. These facts bring to mind the words of a very old book concerning a man who tries to serve two masters.

Omitting the figures above stated to be probably incorrect, the most notable changes in incomes per ton of coal between the years 1892 and 1900 are as follows: Comparing incomes in the latter with those in the former year, it appears that the Bosfon Electric system made a gain of 45, the Haverhill of 67 and the New Bedford of 83 per cent. per ton of coal. On the other hand, between 1892 and 1900, Pittsfield lost 27, Chelsea 31, North Adams 40, and Beverly, to 1899, 45 per cent. of the energy income per ton for the earlier year. At first glance it may be thought that declining incomes per ton necessarily imply lower efficiencies, but this is not conclusive, for the influence of changes in prices has to be reckoned with. Unless prices have risen to a corresponding degree, increasing incomes per ton of coal certainly indicate higher efficiencies. In order to draw certain conclusions as to efficiencies in these 26 electrical systems, it is necessary to determine the movements of the prices they received for electrical energy during the period. It is alike impossible and unnecessary to find the actual prices paid for each class of service, but relative prices from year to year can be ascertained, and this is sufficient for present purposes. For each electrical system the income from sales of electrical energy and the total connected load are given yearly. If the energy income is derived in each case by the number representing the kilowatts of total connected load, the income per unit of connected load in each year is determined, and relative prices are approximately shown, from year to year. The connected load is made up of three items – arc lamps, incandescent lamps and motors. To obtain from these items the equivalent kilowatts of connected capacity, the number of arc lamps is multiplied by 0.4, the number of incandescent lamps by 0.06, and the horse power of motors is taken to represent kilowatts, thus implying an efficiency of 74.6 on an average.

Figures thus obtained for these three kinds of loads are added to obtain the total kilowatts of connected capacity for each system yearly. It is not thought that these kilowatt figures are exact, but it seems that they are sufficiently accurate for present purposes, and that any errors they contain will not operate more strongly in one year than in another. The number representing total kilowatts of connected capacity for each station in any year is used to divide the energy income of the station in that year. These calculations have been carried out for the 26 electrical systems in the years 1802 and 1900. No doubt the general reduction of incomes per kilowatt capacity in connected lamps and motors is due in large part to the fact that the average yearly hours of service to parts of the apparatus have decreased.

Incomes of Electrical Systems per Kilowatt Capacity of Connected Lamps and Motors.

System.	Income, 1892.	Income, 1900.	System.	Income, 1892.	Income, 1900.
Boston Edison.	$66.55	$48.54	Waltham.....	$179.68	$59.06
Boston Electric.	248.66	82.67	North Adams..	201.09	37.87
Lowell	140.39	43.66	Woburn	97.73	46.43
Cambridge	204.00	52.52	Malden.....	152.56	64.09
Pittsfield	99.32	53.27	Haverhill	190.19	58.53
Fall River.....	250.10	76.23	New Bedford..	72.10	48.80
Worcester.....	253.35	99.48	Fitchburg.....	162.71	71.84
Somerville	162.23	75.66	Northampton..	108.70	40.80
Lynn	150.05	55.62	Quincy.....	146.49	49.60
Salem	159.15	51.74	Gloucester.....	171.45	52.13
Brockton.....	73.81	54.27	Beverly.....	228.41	66.93
Chelsea	104.62	51.86	Marlboro.....	132.52	52.72
Newton	130.46	50.52	Newburyport..	209.65	120.03

This decrease is largely due to the great additions of residence lighting. It seems quite certain, however, that varying portions of the reductions in incomes per unit of connected capacity are the result of lower prices. Figures for incomes of the Edison systems at Boston, Brockton and New Bedford support this view, as it seems very improbable that these low pressure plants have taken on enough residence lighting to lower their incomes to the extent indicated. It is also to be noted that these three systems, which have made comparatively small extensions to residences, have lowered their incomes per connected kilowatt capacity less than any of the other plants. Between 1892 and 1900 the income per kilowatt of connected apparatus of the Boston Edison decreased 27, of the Brockton Edison 26, and that of the New Bedford Edison 32 per cent. Meantime the Boston Electric Company, selling in direct competition with the Edison Company, in the territory of the latter, reduced its income per kilowatt of capacity in connected apparatus 67 per cent. How much prices of electrical energy have been reduced in any particular city cannot be determined, because of the variable factor of residence lighting, but that they have been lowered to some extent in every case seems practically certain. With this result in view, it appears that electrical systems which have maintained a nearly constant income per ton of coal, must have increased in efficiency. Even plants where the income per ton has declined may have lost only through lower prices. In the larger number of purely electrical systems the energy income per ton of coal has persistently risen in the face of falling prices. The obvious conclusion is that a very substantial rise in efficiency has taken place during the decade.

Portable Electric Light Plants.

By Mr. Frank C. Perkins, in *Electricity*.

It is frequently necessary to use considerable electric current for arc or incandescent lighting or for power distribution with electric motors in places and localities where a permanent electric light plant would not be available. Heretofore it has been the practice to utilize a steam engine and boiler of the portable or traction type, directly driving a dynamo from the engine shaft or belting the generator to the engine flywheel.

The gas and gasoline engine has now come into such extensive use for all manner of work, and has become so popular, convenient and economical, that this form of power is now employed with portable plants to great advantage. The accompanying illustrations, Figs. 1 and 2, illustrate two electric light or power plants for portable work as constructed at Frankfort-on-the-Main, Germany, by the Elektrizitats Actien Gesellschaft, formerly W. Lahmeyer & Co. The first shows a complete plant mounted upon a truck, which includes a horizontal gasoline or oil engine belted to a bi-polar electric generator of German construction supplying a continuous current. The fuel tank and water tanks are shown for supplying the gasoline and cooling the cylinder, and a magneto dynamo is utilized for supplying the necessary current for igniting the explosive charge. The plant illustrated in Fig. 2 is more compact, as it consists of a Lahmeyer bi-polar direct current dynamo directly connected to a vertical 4-cylinder gas engine.

A similarly constructed 3-cylinder gasoline engine outfit of American make is shown in Fig. 3, driving by link belting an alternating current generator. This American portable electric plant is utilized for operat-

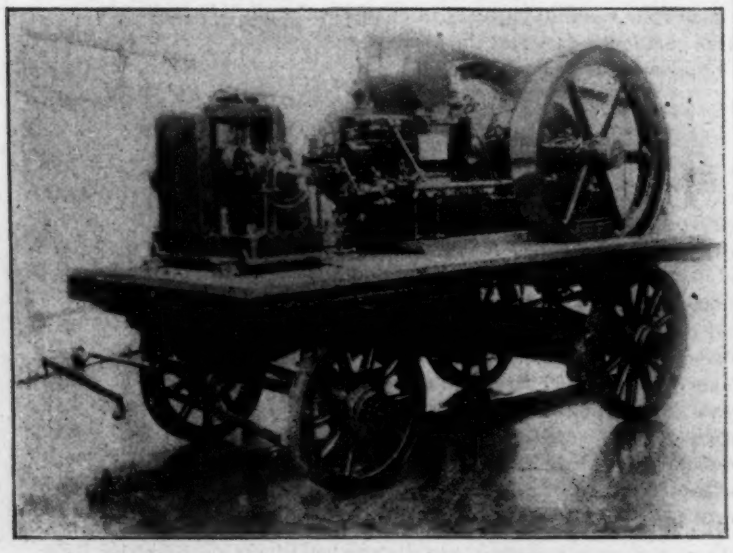

Fig. 1.—A German Belt-Driven Direct Curren Plant.

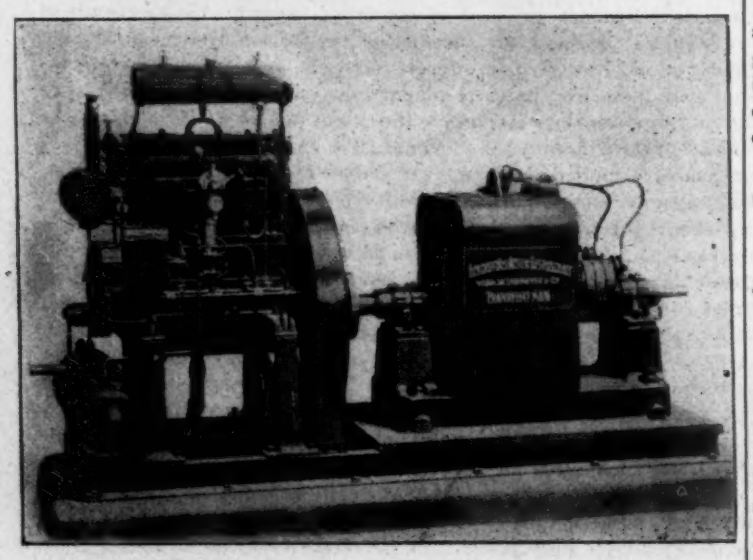

Fig. 2.—German Direct Connected Continuous Current Plant, Using an Internal Combustion Engine.

ing a number of Nernst lamps at a pressure of 220 volts. The engine is of the Walrath type, built by the Marinette Iron Works Mfg. Company, of Marinette, Wis., and has a capacity of 30-horse power. It is of the open base type, which gives a light construction, and operates at a speed of 425 revolutions per minute, the engine cylinder being 8 by 8, and the total weight being 4,460 pounds, including both flywheels. Each cylinder is provided with a cut-off in the mixing yoke, which permits of the governing of the engine speed up to that controlled by the governor, which is of the well known flyball type. This governor controls the proportional valve which graduates the amount of explosive mixture delivered to the cylinders as the load requires. It will thus be seen that this portable plant is capable of taking care of all ordinary changes of load and at the same time maintaining a regulation of 2 per cent. or better.

The igniters are supplied with a hand adjusting device, which permits of the time of spark being changed while the engine is in operation. The valves are actuated from the cam shaft carried on the pillar supporting the base, which is driven by a train of gears from the engine shaft. The engine has valves of positive action and is fitted with a trip igniter.

The alternator has a capacity of 18 kw. and is of the Fort Wayne type, generating a current of 220 volts pressure. The current is utilized for operating in all about 60 Nernst lamps of 6-glower size, illuminating 2 large circus tents. In many other cases portable plants are very desirable and almost a necessity, as in contracting work, where the time of construction is limited and work must be carried on night and day. For operating the Nernst 6-glower lamps it is necessary to provide an alternating current, as this current works better in this form of lamp. The alternator must have an exciter, and in this case the current for exciting the alternator fields is obtained from a small 4-pole direct current machine, noted in Fig. 3, mounted on the platform of the truck

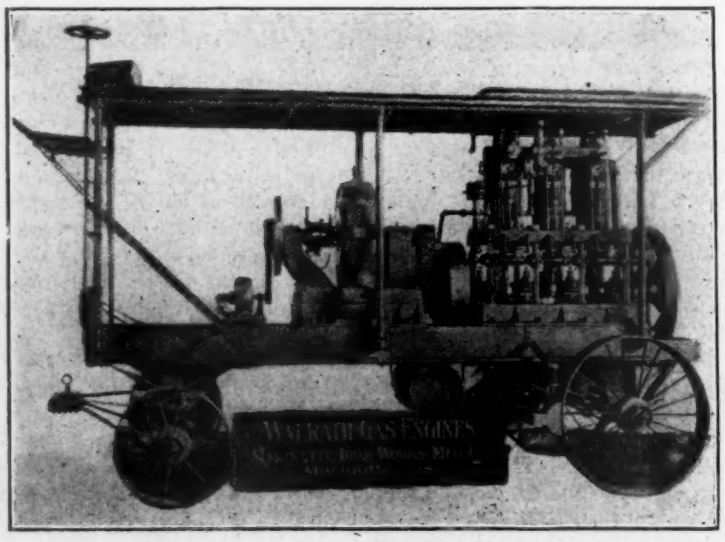

Fig. 6.—American Portable Alternating Current Electric Plant for Operating Nernst 6-Glower Lamps.

and belted to a pulley on the extended shaft of the alternating current generator. For operating motors from a portable plant or for ordinary incandescent or arc lighting on contracting work the continuous current dynamo is as satisfactory in every way as the alternator and is more extensively employed.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

MR. VICTOR RETTICH has resigned from the service of the Kern Incandescent Gas Light Company, of New York city.

THE coal handling machinery installed by the C. W. Hunt Company, West New Brighton, N. Y., at the Lincoln wharf power station of the Boston (Mass.) Elevated Railway Company, recently lowered the world's record for rapid unloading. The coal was raised 90 feet above tide water and delivered to the storage pockets at the rate of 320 tons per hour. The installation follows in general design the standard Hunt steeple-tower rig, the moving gear and coal cracker being electrically driven, the hoisting engine being direct connected. The overhang of the following boom is 40 feet, and the capacity of the shovel 40 tons.

"A. W. R.," Pittsburg, Pa., is informed that Mr. Wm. R. Higby, for many years President of the Bridgeport (Conn.) Gas Light Company, died at his home in that city, September 4th, 1902.

THERE seems to be considerable material value in the shares of the Westminster (Md.) Gas Light Company, if a recent sale of the same at auction may be accepted as a safe indication. There were only 5 shares disposed of (the property belonged to the estate of the late Mr. A. Shriver) and the purchase price was at the rate of 170 per cent.

THE officers, clerks and patrons of the Dallas (Tex.) Gas and Fuel Company are enjoying the freedom and comfort which attend upon the occupying of new, handsome and well fitted office quarters—everyone knows that Thos. D. Miller, Esq., pleaded for such in vain for more than months. However, Manager Mockett's persuasion seems to have prevailed, and the Company's present home is a credit to itself and an ornament to Dallas. A beautifully arranged show room is a feature of the new establishment.

A CORRESPONDENT in San Francisco forwards the following: "Some days ago Robert Bowman, a receiving clerk in the office of the San Francisco Gas and Electric Company, obtained a warrant for the arrest of Jane La Sere, proprietress of a candy store at 36 Hayes street, on a charge of petit larceny. The candy woman, in the usual course of business, called at the office to pay her bill. In counting out the money, she had previously handed in the bill, she protested vigorously against the exorbitance of the amount. Before her protest was finished, and before the coin had been passed over, Mr. Bowman passed out the signed receipt whereupon the candy lady accepted the latter, pushed the money in her reticule and attempted to escape. Of course, she did not get very far away. In the meantime it may be safe to assume that Mr. Bowman is studying the Chinese system of 'No tickee; no washee.'"

THE dear, old people in charge of some of the Government buildings, of Washington, D. C., have been stirred to action by a positive notice from Acting Secretary of the Treasury Taylor which calls severe attention to the waste now going on in the buildings of the currents of gas and electricity that illuminate the same. The advisory and chargeful of lack of caution circular says that "this waste could be avoided by a proper degree of watchfulness on the part of employees, and officials and employees should be instructed to extinguish the lights immediately upon the conclusion of their work." What are the watchmen in the various departments supposed to do? Sleep with the lights turned on! This, however, they could easily do, for the workmen obliged to labor in the various departments cannot in many instances see to do their work properly with the artificial illumination granted them. The average artificial lighting of the many public buildings in Washington is a farce, simply through the parsimony that governs its purchase and distribution.

THE following is from the Richmond (Va.) *Leader* of the 4th inst.: "If the ratio of increase continues for four months the City Gas Department will show a gain of nearly $50,000 in gross earnings for 1903 over 1902. Superintendent Knowles has figured up the receipts for the past 8 months and compared the total with that for the corresponding period last year, with the following results: Cash receipts for 8 months, to September 1, 1903, $179,814.56; receipts for corresponding period, 1902, $149,156.94. Gain for 1903, $30,657.62. The same rate of increase for the next four months of the year will give an excess slightly over $45,000. The ratio of increase, however, should be greater for the unexpired months, for the reason that the consumption of gas is greatest in the fall of the year. As time passes the fear, once entertained, that electricity would supplant gas and decrease the consumption of the latter, vanishes into thin air. While the demand for gas for illuminating purposes is probably not what it would otherwise be, the increased demand for gas for cooking and heating more than makes up the difference." Judging from that which time develops, the *Leader* is, in common with other hitherto delirious advocates of the electric current as a means of making good money on illuminating account, beginning to reach the point of wisdom.

THE E. Young Electric and Gas Company, of Caldwell, Ky., has been incorporated by Messrs. E. Young, John C. Gates and M. J. Groom. The concern is capitalized in $100,000.

THE second largest taxpayer in Lynn, Mass., is the Lynn Gas and Electric Company, the payment of which on such account this year amounts to virtually $14,500.

THE Louisville (Ky.) Gas Company readily disposes of its crushed coke at the rate of 8 cents per bushel.

HERE is a bit of history, recently prepared at the instance of the Citizen's Association, of Cleveland, O., respecting municipal ownership of natural gas supply and distribution to the city of Toledo, O., that seems to carry a useful lesson: "Because of the experiment with the public ownership of a natural gas plant, Toledo now has a bonded indebtedness of $1,050,000, on which 4½ per cent. annual interest is paid. Every year the taxpayers are obliged to come up with $47,250 interest. On this bonded indebtedness they have already paid over $546,000 in interest, and they have nothing to show for the expenditure and the debt except an increased tax rate. Toledo went out of the gas business two years ago. The plant that cost more than $1,000,000 was sold for one-tenth of that sum.

"Ten years ago some wideawake citizens of the town on the Maumee began to talk about the beauties of a city-owned natural gas plant. It was absolutely proved by these advocates of municipal ownership that Toledo could put in a plant, make money out of it, and eventually have a valuable property that would not cost the taxpayers a cent. At the outset it was figured that a few hundred thousand would put in the plant, but the cost doubled, and then trebled. When facts and figures were arrayed against the proposition the sterner advocates of the matter announced that if the plant did nothing but reduce the cost of heating and lighting Toledo homes they would feel perfectly satisfied. After a fight in the Legislature, Toledo was authorized to issue bonds in the sum of $700,000. This was followed by another issue of $350,000. The city natural gas department was active, and soon became the strongest political machine in the city. Mains were put into every locality, and ere long the consumers were enabled to burn gas supplied by the city. Municipal ownership was a reality. Toledo was pointed to by political economists all over the country as a city that was successfully operating a municipal plant other than water works. Try as hard as they could, the natural gas trustees were never able to show that the income of the plant equaled the operating expenses. The transactions of the board were not always made public, and for years the taxpayers did not know how their money was being spent. Statements were issued which presumed to show that the city ought to congratulate itself upon its ownership of a natural gas plant. Matters progressed a few years, when rumors reached the ears of the taxpayers that they had been jobbed. The taxpayers were patient, but finally there was a reaction. They didn't want a municipal gas plant. They insisted that it be sold, and after more agitation, the unearthing of new scandals and proving of old ones, the plant was taken into the court. By order of the court it was sold to the highest bidders. Kerlin Brothers, contractors, bought all the pipe and appliances outside of the city. They paid $102,000 for the 41½ miles of pipe. They dug the pipe up, but they could not find more than 37 miles. There was a shortage of 4 miles. Now the taxpayers are defendants in an action for $23,000, which sum the Kerlins seek to recover because they did not get what they bargained for. Politics played a most important part in the management of the plant. High salaries were paid to political pets. While the managers of the city plant, and those who sought to control it, were fighting over the patronage and boodle, the private company was putting its best foot forward. The pages of local history now show that the municipal plant was swallowed up by the private corporation and the reasons therefor are obvious—viz.: Politics, mismanagement, an attempt to enter the commercial field, lack of enterprise, because what is everybody's business is nobody's business, and, most important, the gross mistake in the first place of the city going into the lighting and heating business."

THE following is from a recent issue of the Kansas City (Mo.) *World:* "The City Council of Kansas City, Kas., has passed an ordinance granting a 30 years' extension franchise to the Wyandotte Gas Company. The Company now has a 20-year franchise, which expires next year. There were two other applicants for the franchise, and after several meetings the Committee on Franchises, consisting of Councilmen Garlick, Laughlin and Briscoe, recommended that the new franchise be granted to the old Company. As the Wyandotte Gas Company and the Kansas City Gas Company are both controlled by the United Gas Improvement Company, of Philadelphia, a greater part of the gas furnished to Kansas City, Kan., was manufactured in the Kansas City, Mo., plant. When the James street bridge, on which the gas main was laid, washed away, it cut off the greater part of the supply, and the present plant, located in Kansas City, Kan., was not large enough to furnish the quantity of gas needed. The poor service rendered by the Wyandotte Company caused many applications to be filed for a franchise on the expiration of the one held by the old Company. However, it was decided to grant the franchise to the Wyandotte Company after its attorney had agreed to the provision in the franchise for the erection of a new plant. The new franchise provides that the Company shall build a new plant within 6 months of sufficient size to supply the city with gas enough to meet any emergency that may arise and that the daily capacity shall be at least half a million cubic feet. The Company is given the right to purchase gas from the Missouri Company until its plant is finished, and in the event of the new plant being temporarily disabled this permission will be extended. The price allowed by the franchise is $1 per 1,000 cubic feet for gas of an illuminating power of not less than 18 standard candles. The price of the street lamps, run on the moonlight agreement, is to be $16 per year. As evidence of good faith the Company agrees to place a bond or securities to the amount of $50,000 to be forfeited should the Company fail to keep its agreement."

AT a recent meeting of the Directors of the Stillwater (Minn.) Gas and Electric Light Company it was voted to ask the shareholders to consent to an issue of bonds in the sum of $350,000, the proceeds of such issue to be devoted to the improvement of the gas and electric divisions of the Company. The gas plant of the property could easily stand for some betterment.

MR. CHARLES CHARVAT, who is the owner of a 30-year franchise for the supplying of gas to the residents of Metamora, Ills., says that the generating plant will be completed before November 1st. Meanwhile, it might be remarked that no street mains have been laid, although the last 10 weeks or so in that section were exceptionally fit for mainlaying work.

THE old Company in Topeka, Kan., has won out completely on every legal point involved in the dispute engineered by the city against it.

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

THOS. J. CUNNINGHAM,
ELBERT P. CALLENDER,
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OHIO GAS LIGHT ASSOCIATION.

NOTIFICATION RESPECTING ADVERTISING.

Orders for new advertising, or for changes in standing advertisements, to insure attention in the issue following their reception, must be in hand any time of Wednesday.

AGENTS:

New York—American News Co., 39 and 41 Chambers St.
Germany—Lemcke & Buechner, of New York.
England—Aug. Siegle, 30 Lime Street, London.

MONDAY, SEPTEMBER 14, 1903.

The Market for Gas Securities.

There is really nothing to chronicle in connection with the share market that is of interest. Trading has been light in volume and the changes in quotations were not of moment. Consolidated closed to-day (Friday) at 174 to 175.

The Company submitted to the New York Stock Exchange a balance sheet (to June 30 last), prior to the listing of the additional stock.

It showed plant and property valued at $46,906.17; cash, $960,050; accounts and bills receivable, $1,708,225; material and supplies, $667,572; investments in stocks and bonds, $52,276,929. The liabilities side includes a charge to surplus and premium account of $15,264,070.

Brooklyn Union is dull and the quotations for it are altogether nominal. Peoples, of Chicago, is fairly steady, and in our opinion it is a decided purchase. This year the Company will, it is estimated, have added 30,000 meters to its service. Cincinnati Gas and Electric shows no particular change in quotations. The general market is slow and steady. Gas bonds continue in good demand, and it is believed that the new 5 per cent. $10,000,000 issue shortly to be made by the San Francisco Gas and Electric Company will readily be placed at par.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

SEPTEMBER 14.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$73,177,000	100	174	175
Central Union, Bonds, 5's.	3,000,000	1,000	105	108
Equitable Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	118	120
Metropolitan	658,000	..	108	112
Mutual	3,500,000	100	280	295
Municipal Bonds	750,000	..	..	..
New Amsterdam Gas Co.. Bonds, 5's	11,000,000	1,000	102	106
Northern Union, Bonds, 5's.	1,250,000	1,000	105	106½
New York and East River Bonds 1st 5's	3,500,000	1,000	102	106
" 1st Con. 5's	1,500,000		109	111
Standard	5,000,000	100	135	140
Preferred	5,000,000	100	155	170
Bonds, 1st Mortgage, 5's	1,500,000	1,000	116	117
Yonkers	299,650	500	130	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	185	200
" " Bonds (5's)	15,000,000	1,000	119	119½
Bay State	50,000,000	50	⅛	3/16
" Income Bonds	2,000,000	1,000	.	75
Binghamton Gas Works	450,000	100	28	30
" 1st Mtg. 5's	509,000	1,000	93	96
Boston United Gas Co.— 1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	4	5
" " Bonds, 5's	5,250,000	1,000	73	76
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Central, San Francisco	1,000,000	..	106	108
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104½
Cincinnati Gas & Elec. Co.	29,500,000	100	94¼	94½
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	101	101½
Columbus (O.) Gas Lt. & Heating Co	1,682,750	100	88¾	89¼
Preferred	3,026,500	100	107⅞	109
Consumers, Jersey City Bonds	600,000	1,000	100	102
Consumers, Toronto	1,700,000	50	218	225
Consolidated, Baltimore	11,000,000	100	65	65¼
Mortgage, 6's	3,600,000	..	..	118
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	112
Consolidated Gas Co. of N.J.	1,000,000	100	15	17
" Con. Mtg. 5's	880,000	1,000	85	87
Consolidated G. & E. Co.'s. Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co.	4,825,500	50	87	95
" Prior Lien 5's	5,603,000	1,000	99½	100
Detroit Gas Co., 5's	382,000	1,000	77	79
" Inc. 5's	16,000	100	98½	100
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	39	40
Fort Wayne	2,000,000	..	..	..
" Bonds	2,000,000	..	55	..
Grand Rapids Gas Lt. Co. 1st Mtg. 5's	1,225,000	1,000	104½	105
Hartford	750,000	25	245	265
Hudson County Gas Co., of New Jersey	10,500,000	..	25	..
" Bonds, 5's	10,500,000	..	101	103
Indianapolis	2,000,000	..	..	65
" Bonds, 6's	2,650,000	..	104¾	106
Jackson Gas Co	250,000	50	73	75
" 1st Mtg. 5's	290,000	1,000	101	102½
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	36
Bonds, 1st 5's	3,822,000	1,000	102	104
Laclede, St. Louis	10,000,000	100	79	90
Preferred	2,500,000	100	85½	..
Bonds	10,000,000	1,000	109½	110
Lafayette Gas Co., Ind.	1,000,000	100	..	60
Bonds	1,000,000	1,000	60	65
Louisville	2,570,000	50	135	140
Madison Gas & Elec. Co. " 1st Mtg. 6's	350,000	1,000	107½	108½
" 6 per cent. scrip, due 1910	100,000	25	85	87
Montreal, Canada	2,000,000	100	218	184¾
Nashville Gas Lt. Co.	1,000,000	100	110	..
Newark, N. J., Con. Gas Co	6,000,000	..	56	58
Bonds, 6's	4,600,000	..	105	105¾
New Haven	1,000,000	25	300	325
Oakland, Cal.	2,000,000	..	46	47
" Bonds	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	93¾	94
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	..	..
2d "	2,500,000	1,000	104	..
Rochester Gas & Elec. Co.. Preferred	2,150,000	50	88	..
Consolidated 5's	2,150,000	50	118	..
San Francisco, Cal.	0,000,000	100	..	..
St. Joseph Gas Co. " 1st Mtg. 5's	751,000	1,000	96	96⅛
St. Paul Gas Light Co.	1,500,000	100	45	47
1st Mortgage 6's	650,000	1,000	113	116
Extension, 6's	600,000	1,000	112½	115
General Mortgage, 5's	2,465,000	1,000	92	93
Syracuse, N. Y.	1,975,000	100	46	48
Bonds	2,047,000	1,000	98¼	99½
Washington, D. C	2,600,000	20	298	305
First mortgage 6's	600,000	..	..	..
Western, Milwaukee. Bonds, 5's	4,000,000	..	109½	110
Wilmington, Del	600,000	50	282	..

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DIVIDEND NOTICE.

OFFICE OF THE UNITED GAS IMPROVEMENT CO.,
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PHILADELPHIA, PA., Sept. 9, 1903

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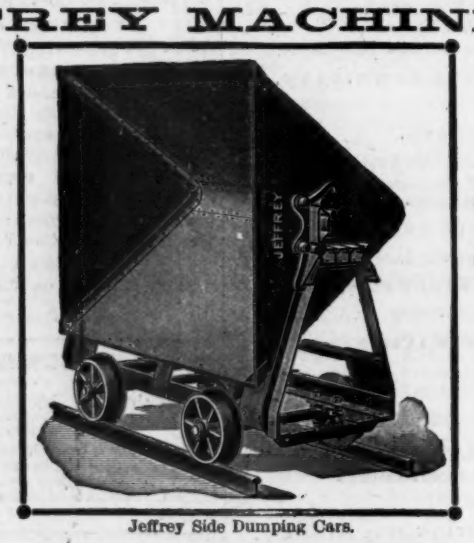

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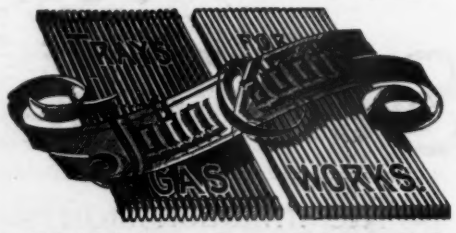

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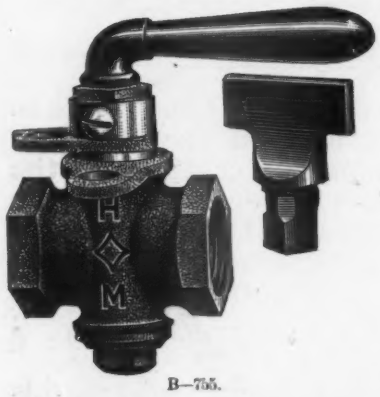

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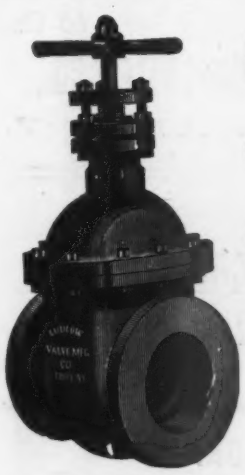

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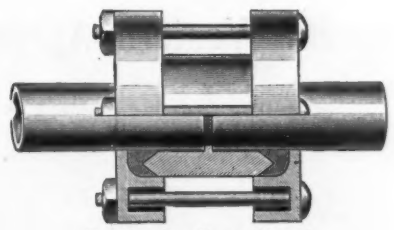

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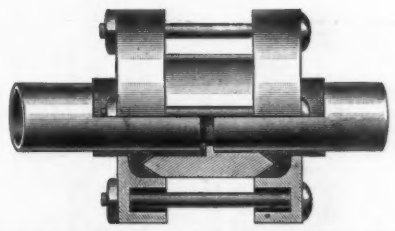

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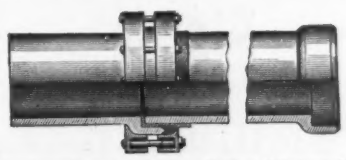

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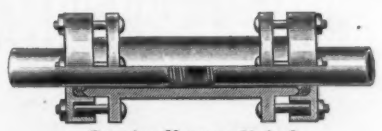
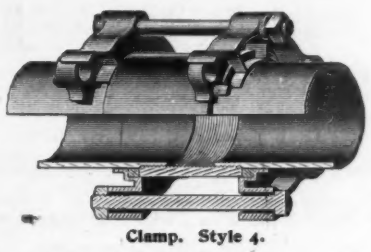


Regular Sleeve. Style 2.



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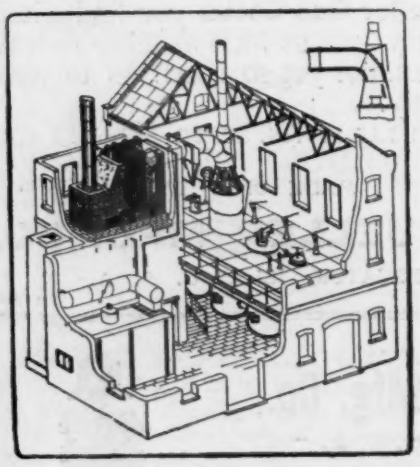

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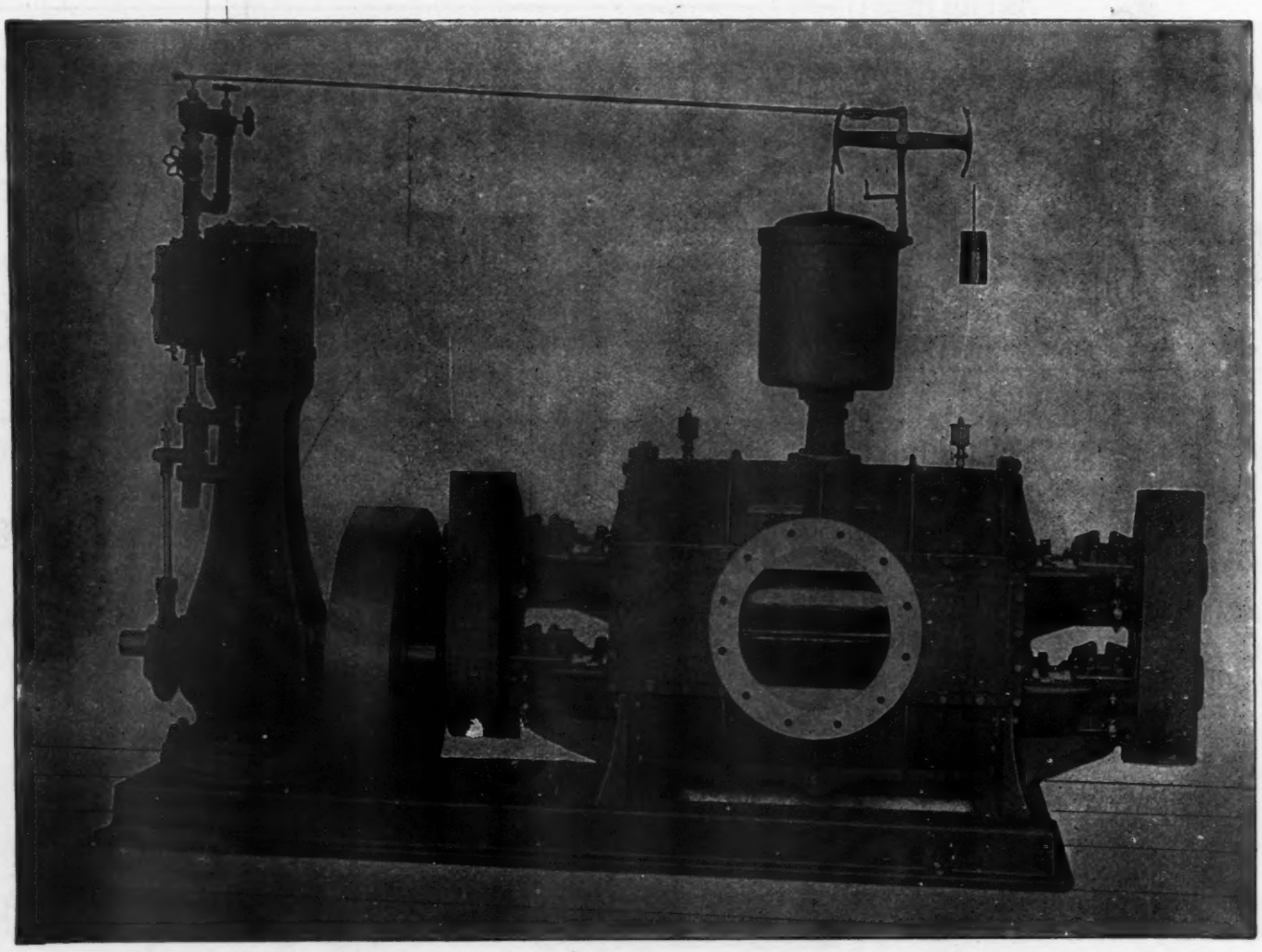

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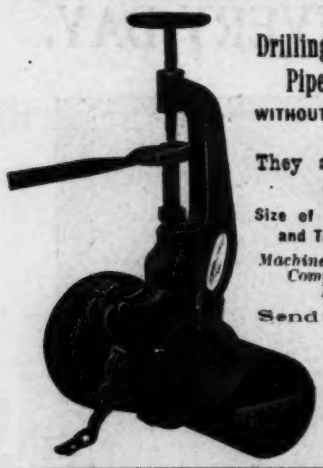

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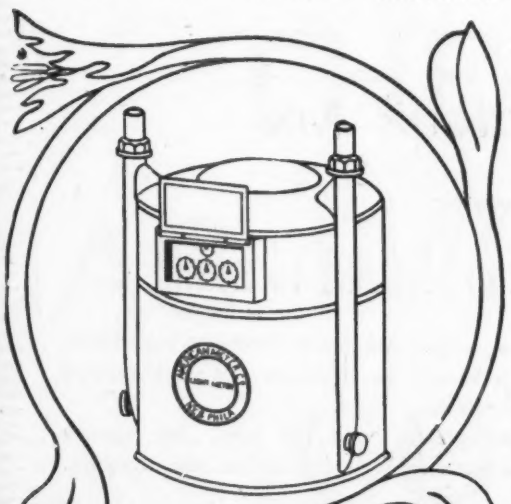
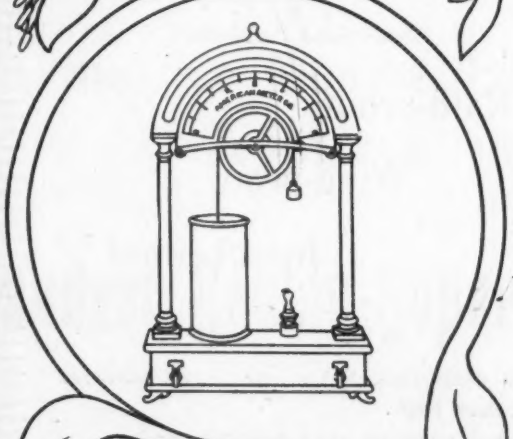
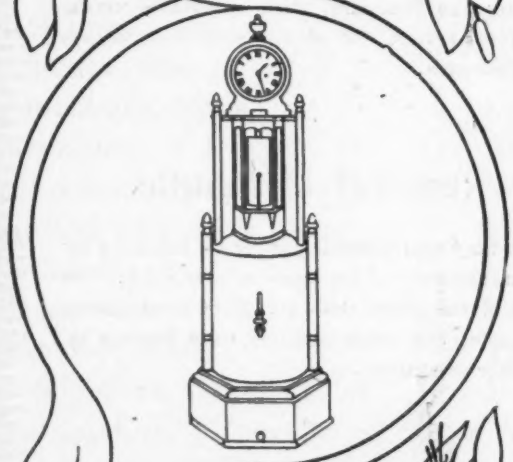
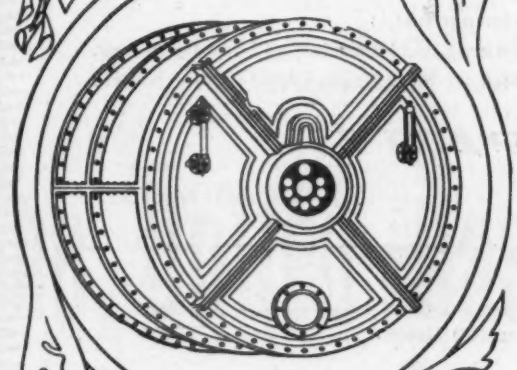




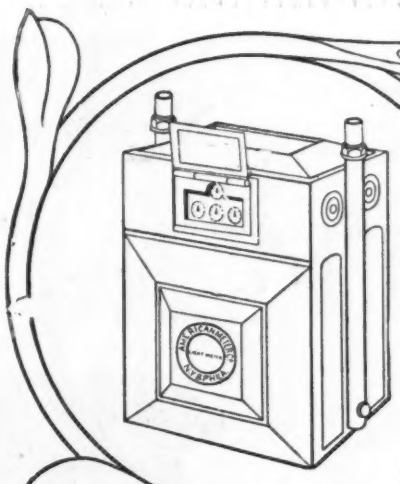


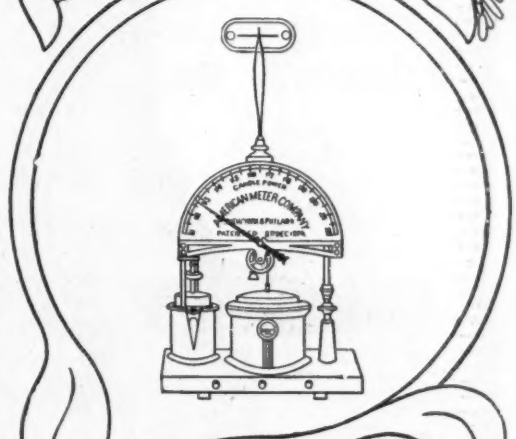


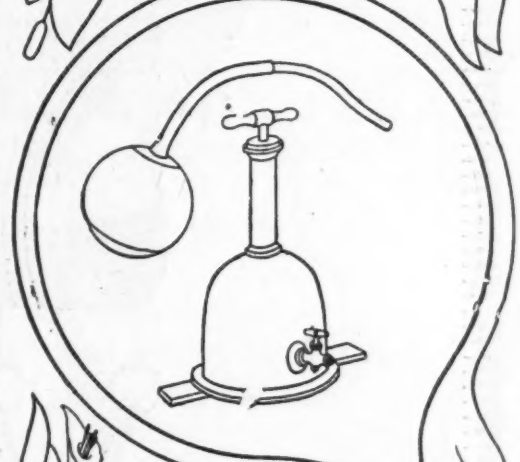
PUBLIC LIGHTING TABLE.

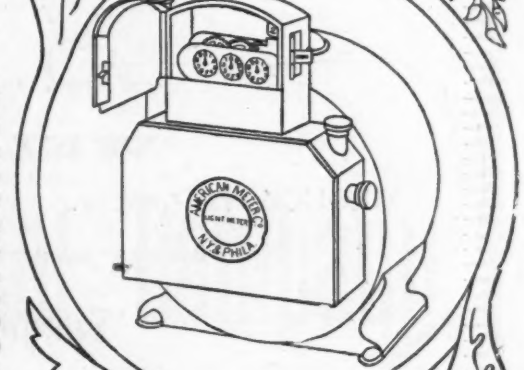
OCTOBER, 1903.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Extinguish's	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Thu.	1	1.00 AM	4.50 AM	5.30	5.00
Fri.	2	2.00	4.50	5.30	5.00
Sat.	3	2.50	4.50	5.30	5.00
Sun.	4	3.50	5.00	5.30	5.00
Mon.	5	No L.	No L.	5.30	5.00
Tue.	6	No L. FM	No L.	5.30	5.00
Wed.	7	No L.	No L.	5.30	5.00
Thu.	8	6.00 PM	8.00 PM	5.20	5.10
Fri.	9	6.00	8.40	5.20	5.10
Sat.	10	6.00	9.20	5.20	5.10
Sun.	11	5.50	10.20	5.20	5.10
Mon.	12	5.50	11.10	5.20	5.10
Tue.	13	5.50 LQ	12.20 AM	5.20	5.10
Wed.	14	5.50	1.20	5.20	5.10
Thu.	15	5.50	2.30	5.10	5.20
Fri.	16	5.50	3.40	5.10	5.20
Sat.	17	5.50	5.10	5.10	5.20
Sun.	18	5.40	5.20	5.10	5.20
Mon.	19	5.40	5.20	5.10	5.20
Tue.	20	5.40 NM	5.20	5.10	5.20
Wed.	21	5.40	5.20	5.10	5.20
Thu.	22	5.40	5.20	5.00	5.30
Fri.	23	5.40	5.20	5.00	5.30
Sat.	24	5.40	5.20	5.00	5.30
Sun.	25	8.10	5.20	5.00	5.30
Mon.	26	9.00	5.20	5.00	5.30
Tue.	27	10.00 FQ	5.20	5.00	5.30
Wed.	28	10.50	5.20	5.00	5.30
Thu.	29	11.50	5.20	4.45	5.35
Fri.	30	12.40 AM	5.20	4.45	5.35
Sat.	31	1.40	5.20	4.45	5.35









TOTAL HOURS LIGHTING DURING 1903.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	245.00	January	423.20
February	192.00	February	355.25
March	201.00	March	355.35
April	167.20	April	298.50
May	152.00	May	264.50
June	131.00	June	234.25
July	140.40	July	243.45
August	156.20	August	280.25
September	171.20	September	321.15
October	198.20	October	374.30
November	216.30	November	401.40
December	232.10	December	433.45
Total, yr.	2203.40	Total, yr.	3987.45

No. 904 Welsbach Outdoor Arc

Furnished with 2, 3, 4 or 5 Burners

This Lamp is Built to Stand

rough usage and severe weather conditions. In mechanical construction and workmanship it is perfect.

The material is of the best. All exposed metal parts made of cold rolled sheet copper.

Guaranteed Positively

Rain-proof

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Insect-proof

The main cock lights one or all burners. Pilot flash light.

18-inch enameled steel reflector shade.

Long tube burners, with adjustable needle gas feed, permit use of either 3½-inch or 4½-inch mantles.

Renewal of Mantle

made easy and without danger of breakage by raising the body of the lamp on main stem. The neck of the globe thus acts as a wind guard, protecting the other mantles from damage by weather conditions.

Candle Power Test

of 4-burner lamp:

With 3½-inch mantles, 412-candle power.

With 4½-inch mantles, 503-candle power.

WELSBACH COMPANY,

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Sample Case of 3, 6 or 12 lamps sent on 30 days' approval at prices based on 100 lamps.

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Chicago, Ills.	Chester, Pa.	Allentown, Pa.
Amesbury, Mass.	Lynn, Mass.	Savannah, Ga.
Aberdeen, S. D.	Newark, N. J.	New York (Central Union Co.)
Winsted, Conn.	Washington, D. C.	Cicero, Ills.
Canon City, Col.	Boone, Ia.	Chicago (Ogden Co.)
Schenectady, N. Y.	Pueblo, Col.	Easton, Pa.
Hagerstown, Md.	Charlotte, N. C.	Lawrence, Mass.
Malden, Mass.	Fall River, Mass.	Council Bluffs, Ia.
Bridgeport, Conn.	Duluth, Minn.	Chattanooga, Tenn.
Albert Lea, Minn.	New York (Mutual Co.)	

TOTAL SETS TO JULY 1, 1903, ... 51
TOTAL DAILY CAPACITY, ... 55,150,000 cubic feet.
TOTAL SETS TO DATE, ... 498
TOTAL DAILY CAPACITY, ... 354,830,000 cubic feet.

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Established 1858. Incorporated 1890.
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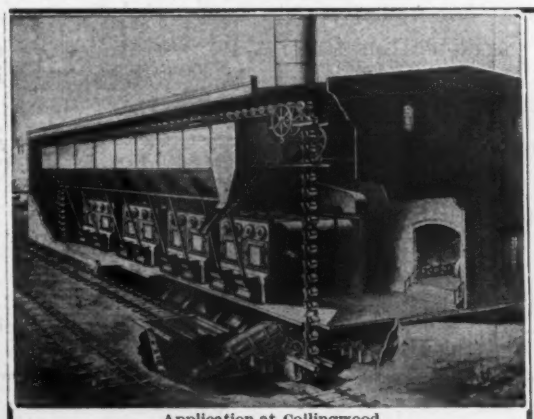

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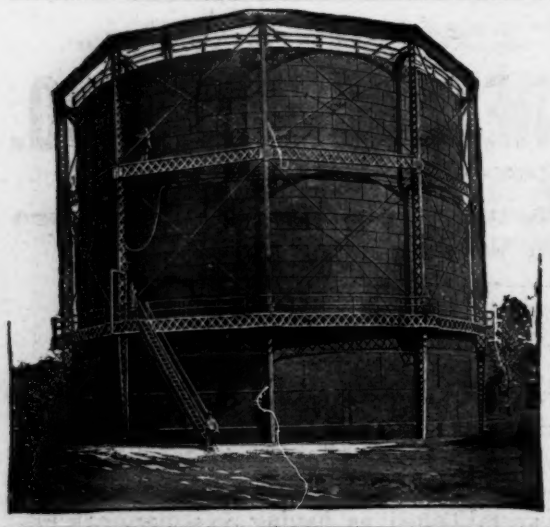

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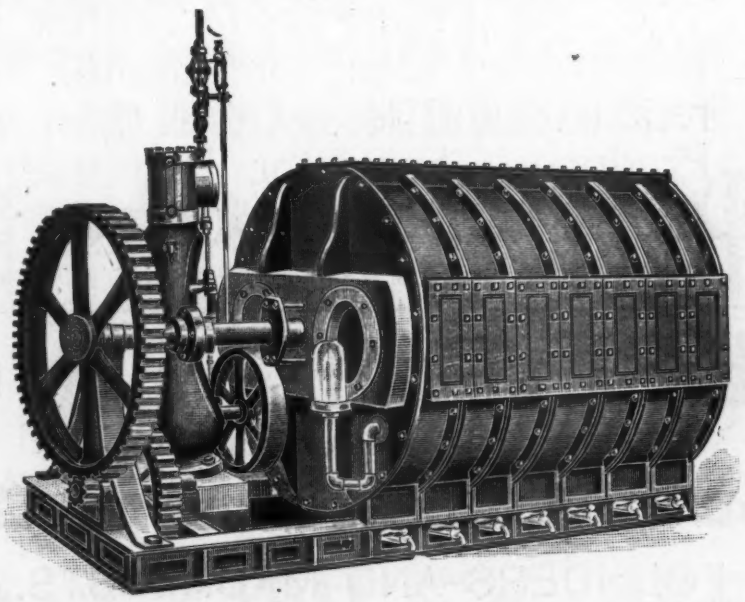

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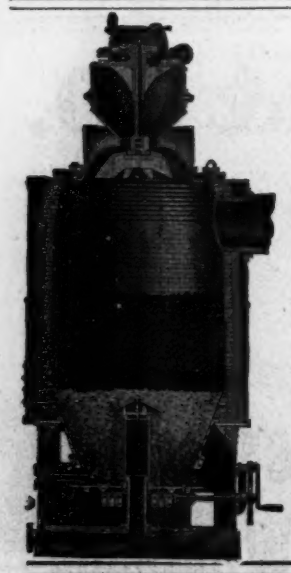

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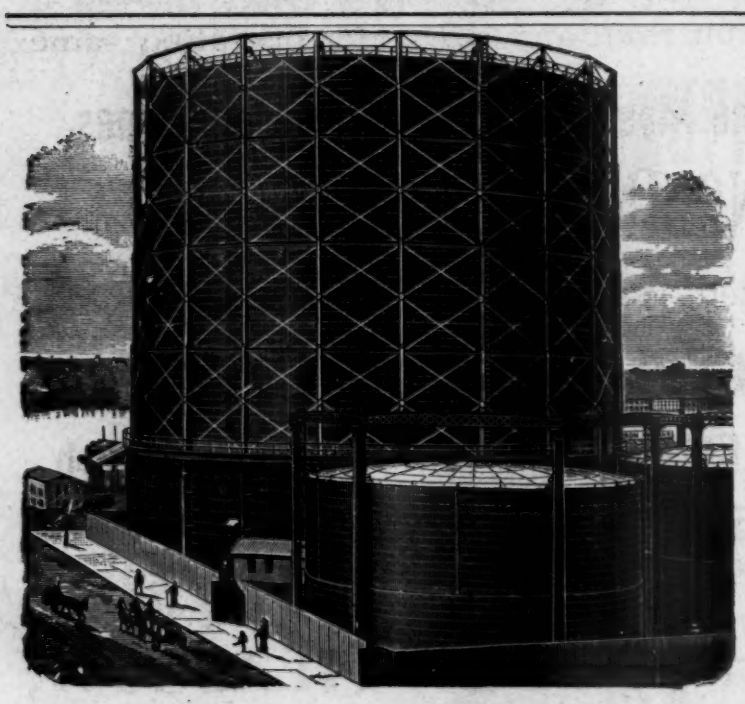

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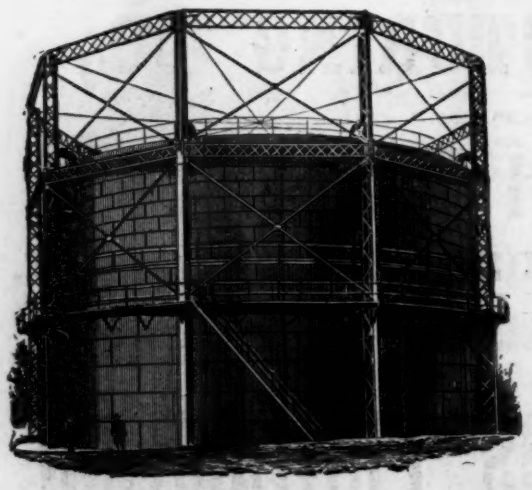

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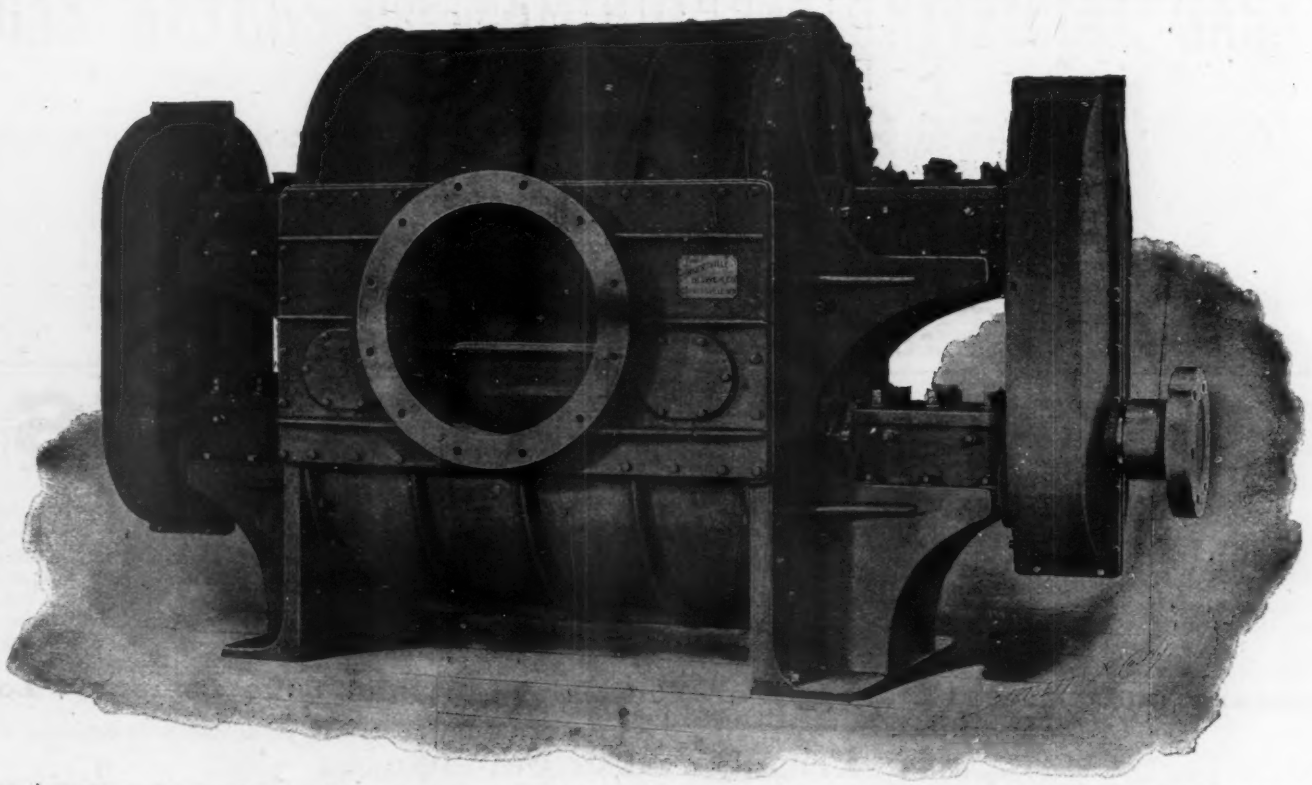

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